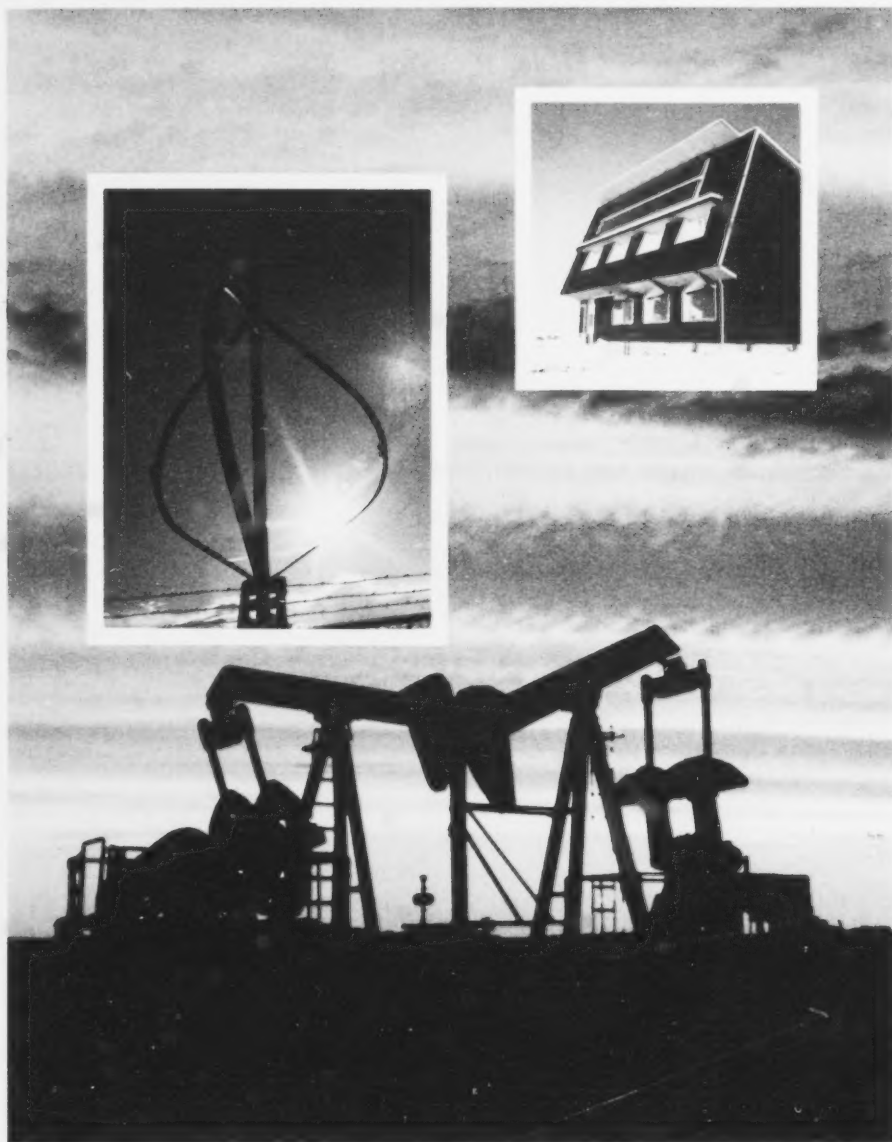




Saskatchewan
Mineral Resources

November, 1977

Energy Resource Management In Saskatchewan



The pictures on the cover depict three energy activities in Saskatchewan:

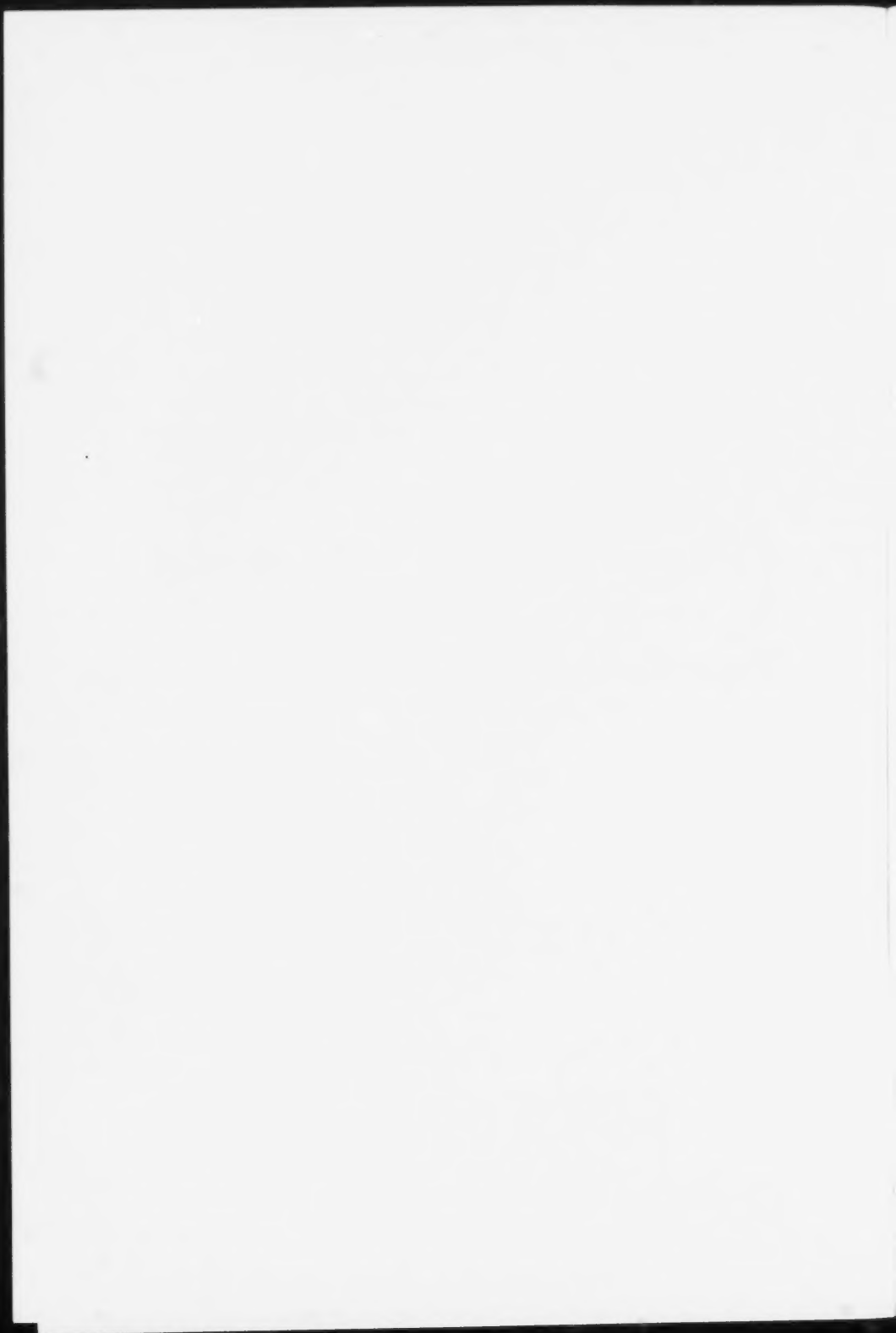
1. an oil pump jack against a prairie sunrise in southeastern Saskatchewan.
2. an experimental wind turbine under evaluation in Regina by the Research and Development Centre of the Saskatchewan Power Corporation.
3. an energy conservation and solar energy demonstration house in Regina sponsored by the Department of Mineral Resources and the Saskatchewan Housing Corporation.



Energy Resource Management In Saskatchewan



Miscellaneous Report 78-2



Foreword

Since 1973, when the Organization of Petroleum Exporting Countries (OPEC) temporarily curtailed exports of crude oil and dramatically increased the price of this commodity, the interest in and importance attached to energy matters has increased substantially. In the ensuing four years, the Saskatchewan Government has taken a number of policy, legislative, fiscal and organizational initiatives in order to more appropriately manage provincial energy resources on behalf of Saskatchewan residents. This publication is intended to outline these initiatives in general terms, and to indicate the principles and practices which the Government applies to manage the social, economic and environmental aspects of energy resources in the interests of the people of the province.

While largely current in perspective, *Energy Resource Management in Saskatchewan* also indicates some of the longer term energy problems with which we will have to deal. The resolution of these problems is going to require a much greater emphasis on energy conservation, as well as a shifting away from our heavy dependence on relatively scarce energy resources to a greater reliance on renewable and more abundant nonrenewable sources of energy.

Since the focus of this publication is largely on the current situation, it does not outline the many energy planning and development initiatives undertaken by Saskatchewan Government agencies over the last 30 years. For example, the establishment of the Saskatchewan Power Corporation and the passage of the Rural Electrification Act have brought immeasurable benefits to Saskatchewan residents, particularly to the farming community. The creation of this crown corporation also led to the establishment of a unified system of distributing natural gas throughout most parts of the province. An outline of these initiatives and their importance to Saskatchewan is, in its own right, worthy of a publication.

The reference to an "energy crisis" is somewhat overused these days, and this can lead to an unfortunate credibility gap. But there is no doubt that energy resource management is an issue that will be of great concern to us in the years ahead.

I feel that *Energy Resource Management in Saskatchewan* will help the people of this province gain a better understanding of Saskatchewan's energy situation. While this document is not intended to outline detailed solutions to long-term problems, it does provide a factual basis on which we can discuss issues related to the management of our energy resources.

Further work is required to determine Saskatchewan's energy options in specific terms, so that the Province can select an appropriate energy strategy. This strategy must ensure that our energy demands and supplies are kept in an appropriate balance. It must also reflect the social, environmental and economic implications of energy activities.

John R. Messer,
Minister of Mineral Resources.

Energy Resource Management in Saskatchewan

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Glossary of Terms

Abbreviations

bbl	—	barrel
Bcf	—	one billion (one thousand million) standard cubic feet
BTU	—	British thermal unit; the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit
Kwh	—	kilowatt hour
lb	—	pound
M	—	thousand
Mcf	—	one thousand standard cubic feet
MM	—	million
MMM	—	billion (one thousand million)
MMMM	—	trillion (one million million)
MW	—	megawatt (1 000 kilowatts)
RPP	—	refined petroleum products
scf	—	standard cubic feet
SPC	—	the Saskatchewan Power Corporation, a crown corporation which supplies almost all of the natural gas and electricity requirements of the province

Definitions

(Energy) refined petroleum products — the same as "refined petroleum products" except that it excludes those refined products which cannot be used to satisfy energy requirements (e.g., lubricating oils and greases, asphalt).

Final energy consumption — energy consumption by the ultimate user. This excludes (among other things) some energy use by the energy supply industries as well as energy which is "lost" in converting energy from one form to another.

Gross Domestic Product — a measure of the total flow of goods and services produced by the economy over a particular time period, normally a year.

OPEC — the Organization of Petroleum Exporting Countries.

Primary energy — energy commodities in unprocessed form (crude oil, natural gas, coal, uranium and hydraulic power).

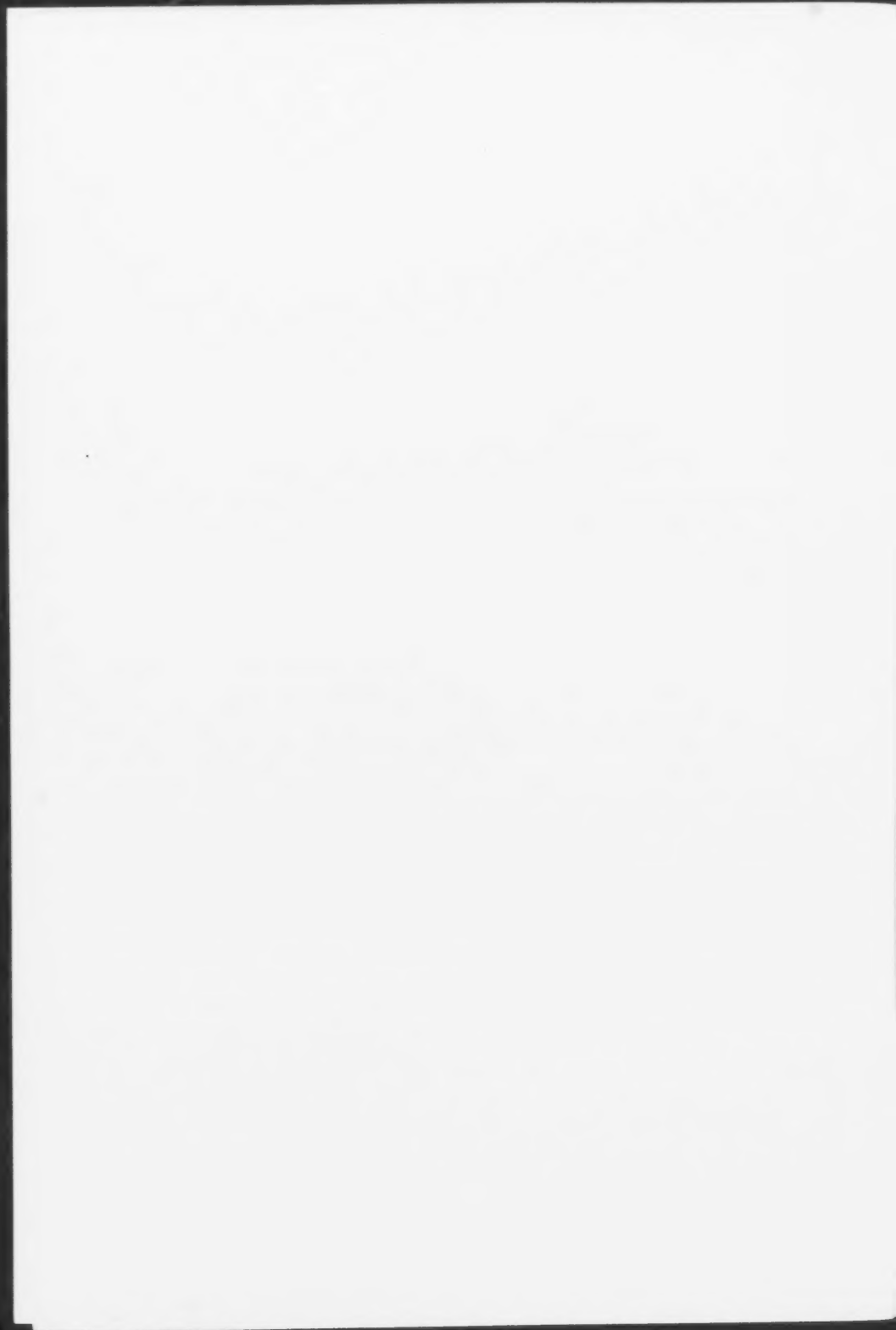
Refined petroleum products — refers to the end products resulting from the refining of crude oil: propane, butane, gasoline, naptha, kerosene, jet fuel, diesel fuel, lubricating oil, heavy fuel oil, asphalt, coke, etc.

Reserve — that portion of the currently identified "resource" from which a useable energy commodity can be economically extracted at the time of determination using currently available technologies.

Resource — as applied to energy mineral resources, all oil, gas, coal or uranium accumulations which are known or inferred to exist.

Secondary energy — energy commodities in a form which can be used by the ultimate user (e.g., natural gas, refined petroleum products, electricity). In certain cases, this involves the processing or converting of primary energy commodities to secondary energy commodities (e.g., crude oil to refined petroleum products).

Ton — short ton of 2000 pounds.



Chapter 1

Introduction

In recent years, the proper management and use of energy resources have become increasingly important — in Saskatchewan, Canada and much of the world. From Saskatchewan's perspective, this growing importance derives from three basic characteristics of energy, namely its social, economic and environmental significance to the residents of the province.

Energy's social importance is due to the fact that it is a basic necessity to the way of life of Saskatchewan residents. First, the province's geography and climate require the use of energy simply for people to stay warm during most of the year. Second, like other people in the rest of the industrialized world, Saskatchewan residents require energy to drive the machines on which their material standard of living has come to depend. Both at work and at home, this society depends almost completely upon machinery — and energy to drive that machinery — such as tractors, mining equipment, steel mills, computers, television sets and cars. This reliance on energy, therefore, requires proper management to ensure that the province's energy demands and supplies remain in appropriate balance.

Energy's economic importance results from Saskatchewan's and the industrialized world's almost complete reliance on non-renewable forms of energy, and the fact that non-renewable resources become more costly over time. This follows from the understandable practice of attempting to extract and utilize the less-costly resources first, and developing the more expensive resources afterwards.

While the prices of fossil fuels remained virtually unchanged for many years, Canada and Saskatchewan are now in the process of having to begin to utilize much more costly sources of energy. For example, in 1976 the wellhead price of natural gas in Saskatchewan was about 20 cents per thousand cubic feet (Mcf); if additional gas supplies are to be obtained from northern Canada or from synthetic natural gas made from Saskatchewan lignite coal, the cost of such gas could be 10 to 15 times higher than this. The wellhead price of Saskatchewan oil was about \$2.50 per barrel in 1972; it could cost 6 times that amount to produce Saskatchewan's heavy crude oil by means of thermal recovery techniques and to upgrade it to a level which would be suitable for use in Canadian refineries. While it is true that

in 1973 the OPEC oil cartel initiated the process of increasing energy prices, the result was a speeding up by a number of years of what would have occurred in any case.

This situation of energy prices rising faster than the prices of other commodities creates both costs and benefits for Saskatchewan residents. The challenge in terms of costs is to minimize the price which Saskatchewan energy users must pay in order either to obtain additional energy supplies or to reduce their energy demands. The opportunity in terms of benefits is to ensure that the owners of Saskatchewan's energy resources — the people of the province — receive the greatest economic benefit from the development of these resources. With respect to both the Saskatchewan energy user and the Saskatchewan taxpayer, therefore, the proper economic management of energy resources is a high priority.

The environmental importance of proper energy management has received greater appreciation in recent years. Its significance follows from the fact that every form of energy which is bought or sold carries the potential for environmental degradation in its production, conversion, transportation or consumption. By reducing energy demands, shifting to some of the renewable sources of energy which are non-polluting, or investing in appropriate environmental measures, the environmental costs of energy-based activities can be reduced.

These three aspects of energy resource management — social, economic and environmental — form the basis for the chapters which follow. A further important element of energy resource management in the province is the contribution made by the three energy crown corporations (the Saskatchewan Power Corporation, the Saskatchewan Oil and Gas Corporation, and the Saskatchewan Mining Development Corporation). While public ownership of energy enterprises is not an objective per se of energy management in Saskatchewan, it is a useful (and sometimes the only) means of appropriately managing the social, economic and environmental aspects of energy outlined in this chapter. While various examples are provided in subsequent chapters of the ways in which these Saskatchewan-owned and controlled enterprises assist in the appropriate management of provincial energy resources, it is worth listing here the major types of benefits which they confer:

1. these corporations provide the Province with the option to initiate, on its own and in a timely and well-designed manner, various energy resource developments (e.g., exploration and development activities by "Saskoil" or SMDC);

2. because the time horizon of crown corporations is indefinite, and because they are not so restricted by short term profitability considerations, they can explore for and discover energy resources without necessarily having to produce them at an early date (e.g., SPC has been exploring for and acquiring natural gas and coal reserves since the 1960's);
3. it is often easier to achieve particular social and economic objectives through a crown corporation than by establishing a series of restraints/requirements for a non-crown corporation by means of regulation (e.g., the Saskatchewan Power Corporation provides natural gas and electricity to Saskatchewan residents in many parts of the province who would not enjoy the benefits of these services if only the private sector was involved in these business activities);
4. Saskatchewan ownership ensures that the head offices of such corporations are located in the province, which means more managerial and research positions for Saskatchewan residents. It also means that these corporations will tend to select employees with a Saskatchewan background where candidates who otherwise have equal qualifications apply for employment;
5. being publicly-owned, these corporations ensure that profits from energy resource development in the province accrue to the owners of these resources — the residents of Saskatchewan;
6. public enterprises provide government with a better understanding of the business world and, therefore, a better ability to design appropriate energy policies.

This document is concerned with the importance of proper energy resource management, and with the principles adopted and measures taken by the Saskatchewan Government to achieve this management. The types of governmental measures taken include information, regulation, expenditures and the operation of energy crown corporations. Public statements by the Government (of which this document is an example) comprise the information measures. Subsequent chapters refer to regulatory and expenditure measures, and the role of energy crown corporations.

Chapter 2 (Energy Supply and Demand) outlines the information or statistical base upon which all energy analysis and management depends. It provides a brief history of energy demand and supply in Saskatchewan over the last 13 years and discusses energy forecasting activities which are underway.

Chapter 3 (Energy Conservation) outlines the importance and practice of energy conservation in Saskatchewan. The management of energy demand is an increasingly useful means of helping to satisfy energy requirements at a lower cost — lower in terms of the depletion of non-renewable energy resources, in terms of economic cost and in terms of possible environmental damage.

Chapter 4 (Security of Energy Supply) outlines the measures taken by Saskatchewan to ensure relatively secure energy supplies at a reasonable cost to the province.

Chapter 5 (Economic Benefits from Energy Resources) outlines the principal means by which the economic benefits of energy resource development in Saskatchewan are maximized for the residents of the province. One of the most important of these methods — that of receiving a fair return for provincial resources — is the subject of Chapter 6 (Public Revenue from Energy Resources). It includes a recent history of public revenue from Saskatchewan's largest source of energy revenue — crude oil production.

Chapter 7 (Energy and the Environment) outlines the importance of environmental protection in energy resource management, and the measures taken by the Province to ensure this protection.

Chapter 8 (Energy Research and Development) discusses the importance and practice of research into and development of energy technologies of particular relevance to Saskatchewan, investigation which is necessary to improve the scientific knowledge of energy recovery, conversion, transportation and utilization in the province.

Chapter 9 (The Long Term Energy Situation) discusses Saskatchewan's energy future from a longer-range point of view, and outlines several new initiatives by the Province to more adequately deal with the longer-term energy situation.

Chapter 2

Energy Supply and Demand

Introduction

Energy is an extremely important and very complicated part of daily life in Saskatchewan. Its importance is due to the extensive reliance on this commodity for a high material standard of living and comfort. Its complexity is due to the fact that energy takes several forms and is used in many different ways at work and at home. The purpose of this chapter is to briefly outline the "energy system" in Saskatchewan and the changes which have occurred in it during the recent past, as well as to comment on the forecasting of changes in the energy system.

The "Energy System"

The expression "energy system" refers to the levels and types of energy flows in Saskatchewan over a period of time, on an annual basis. The Department of Mineral Resources recently published a detailed statistical outline of these energy flows, entitled *Saskatchewan Energy Flow Accounts, 1963-1975*. These Accounts outline on an annual basis the sources and end-uses of virtually every type of energy which is produced or consumed in the province. For each energy commodity, the Accounts outline (among other things) Saskatchewan's production, imports, exports, changes in inventory, losses through conversion, and final consumption by 10 types of consumers or "end-use categories".

A summary of these flows for 1963 and 1975 is provided in Table 2-1. While innumerable statistics could be taken from the Accounts and interpretations provided of the changes over time, the purpose here is to examine the earliest and most recent years for which detailed data is available, and to outline the broad changes in the energy system during this period. Table 2-1 outlines total final energy consumption and a breakdown of the total sources of energy, measured in British Thermal Units or BTU's. The measurement of energy in terms of BTU's allows for direct comparison between different energy commodities (e.g., natural gas and electricity).

Energy Production

Reading Table 2-1 in conjunction with Table 2-2 (which outlines the level of production of primary and secondary energy commodities, 1963 and

1975) indicates the following major changes in the supply side of Saskatchewan's energy system:

1. total production of primary energy has decreased by 41%, largely accounted for by a 64% decrease in uranium production but also partly by a 17% decrease in crude oil production. Production of natural gas, coal and hydro has increased by 17%, 109% and 173% respectively;
2. secondary energy production decreased by over 11% as a result of a decrease in the production of (energy) refined petroleum products (25%) which more than compensated for a substantial increase in electricity production (136%);
3. the vast majority of primary energy production is exported, while only a small portion of secondary energy is exported;
4. in 1963, total production of primary energy (1291 trillion BTU's) was more than 9 times greater than total final energy consumption (126 trillion BTU's). By 1975, the ratio of total primary energy production (761 trillion BTU's) to total energy consumption (226 trillion BTU's) had decreased to 3.4. While Saskatchewan still produces substantially more energy than is consumed in the province, this excess of production over consumption dropped considerably during 1963-75.

The annual levels of primary and secondary production of energy commodities in Saskatchewan, 1963-1975, are outlined in Figure 2-1.

Energy Consumption

The consumption side of the provincial energy system is no less complicated than the production side. Table 2-3 provides a breakdown of provincial energy consumption in 1975, by end-use category (type of consumer) and by energy commodity. A comparison of the changes in these consumption patterns between 1963 and 1975, in terms of end-use categories and energy commodities, is provided in tables 2-4 and 2-5. The annual levels of Saskatchewan final energy consumption by end-use category and energy commodity, 1963-1975, are outlined in Figures 2-2 and 2-3. A commentary on each of the end-use categories is provided below.

Residential

The demand for energy in the residential sector is primarily for space heating, with lesser amounts used to power household appliances, including lights. The level of this demand is determined largely by the number and energy-efficiency of housing units (including farm residences) and the number and energy-efficiency of household appliances.

In 1963, the residential sector was the single most important consumer of energy, accounting for 25.8% of total energy consumption. By 1975, this proportion had declined to 21.2%. The major portion of residential consumption is met by natural gas, with lesser amounts supplied by light fuel oil (primarily in rural areas) and electricity. Almost no coal is used in this end-use sector.

Table 2-1

Total Energy Flows in Saskatchewan, 1963 and 1975
(MMMM BTU's)

	1963	1975	% Increase (Decrease)
Primary Energy Supply			
Production (+)	1,291	761	(41.1)
Imports (+)	117	135	15.4
Exports (-)	1,191	630	(47.1)
Converted to Electricity (-)	28	63	125
Converted to RPP (-)	119	92	(22.7)
Losses & adjustments (-)	36	26	(27.8)
Net Primary Supply	35	85	142.9
Secondary Energy Supply			
Production (+)	107	95	(11.2)
Imports (+)	12	53	361.0
Exports (-)	16	11	(31.3)
Converted to Electricity (-)	4	—	—
Losses & adjustments (-)	10	(4)	(140.0)
Net Secondary Supply	89	141	58.4
Total Net Supply	124	226	82.3
Total Final Energy Consumption	126	226	79.4

(+ or -) indicates whether the particular energy flow is to be added or subtracted in calculating net (primary or secondary) supply.

Columns may not add up to totals, due to rounding to nearest trillion BTU's.

Source: **Saskatchewan Energy Flow Accounts**,
Department of Mineral Resources,
February, 1977.

Table 2-2

Production of Energy Commodities in Saskatchewan, 1963 and 1975

Energy Commodity	1963			1975			% Increase (Decrease)
	Natural Units	MMMM BTU's	% Share	Natural Units	MMMM BTU's	% Share	
Primary							
Uranium (Mlbs)	3,949	790	61.2	1,433	287	37.7	(63.7)
Coal (Mtons)	1,874	25	1.9	3,912	52	6.8	108.8
Crude Oil (Mbls)	71,304	414	32.1	59,349	344	45.2	(16.8)
Natural Gas (MMscf)	59,273	59	4.6	69,588	70	9.2	17.4
Hydro (MMkwh)	989	3	0.2	2,703	9	1.2	173.3
Total Primary Production		1,291	100.0		761	100.0	(41.0)
Secondary							
Electricity (MMkwh)	2,991	10	9.3	7,059	24	25.3	136.0
(Energy) refined products (Mbbls)	17,439	96	89.7	13,052	71	74.7	(25.2)
Total Secondary Production		107	100.0		95	100.0	(11.2)

Columns may not add up to totals, due to rounding.

Source:

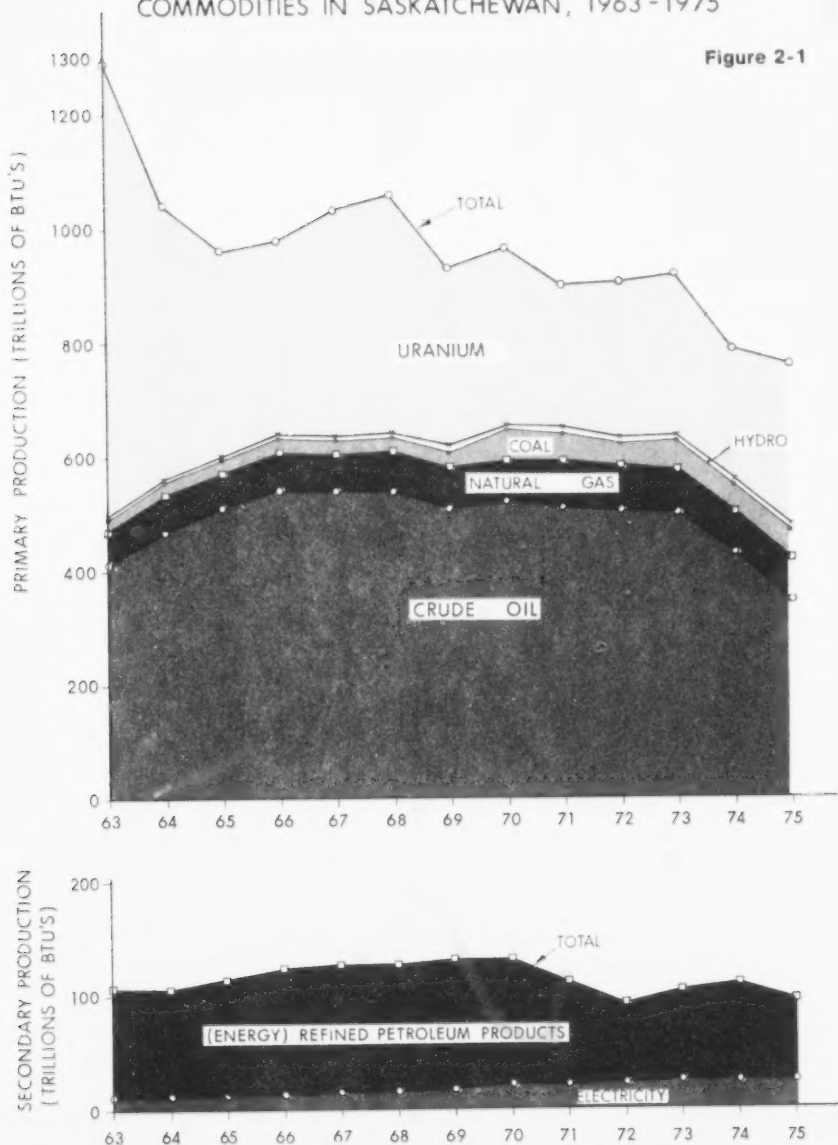
Saskatchewan Energy Flow Accounts,

Department of Mineral Resources,

February 1977.

PRIMARY AND SECONDARY PRODUCTION OF ENERGY COMMODITIES IN SASKATCHEWAN, 1963-1975

Figure 2-1



Source: Same as Table 2-2

Note: The vertical scale of the lower graph is double that of the upper graph

Table 2-3

Saskatchewan Final Energy Consumption By End-Use Category and Energy Commodity, 1975
(MMM BTU's)

Energy Commodity

End-Use Category	Motor Gasoline	Diesel	Kero- sene	Light Fuel	Heavy Fuel	Avia- tion Gas	Avia- tion Turbo	Coal	Natural Gas	Elec- tricity	Total Con- sumption
Residential			8,045	6,270	3			30	27,272	6,292	47,911
Industrial											
Agriculture	23,127	14,261								1,320	38,709
Mining and Smelting	147	772	13	503	76			709	20,079	7,165	29,465
Manufacturing	2,586	5,028	87	790	791			683	12,467	2,129	24,561
Commercial	862	970	114	814	122				23,140	4,504	30,526
Transportation											
Road — Personal	37,735										37,735
Road — Business	2,162	6,742									8,904
Rail		4,179	135	76	364			37			4,791
Air						642	2,909				3,551
Marine											2
Total Final											
Energy Consumption	66,620	31,954	8,394	8,454	1,357	642	2,909	1,459	82,957	21,410	226,155

Source: **Saskatchewan Energy Flow Accounts,**

Department of Mineral Resources,

February, 1977.

Columns and rows may not add up to totals, due to rounding.

Table 2-4

Saskatchewan Final Energy Consumption By End-Use Category, 1963 and 1975

End-Use Category	1963			1975			Compound Annual Rate of Increase (Decrease)
	(MMM BTU's)	(% Share)	(MMM BTU's)	(MMM BTU's)	(% Share)	(% Share)	
Residential			32,632	47,911	17.1	21.2	3.3
— Agriculture	27,804	22.0		38,709			2.8
— Mining & Smelting	5,757	4.6		29,465	13.0		14.6
— Manufacturing	11,961	9.5		24,561	10.9		6.2
Industrial Total	45,522		36.1	92,735		41.0	6.1
Commercial			17,808	30,526		13.5	4.6
— Road — Personal	20,475	16.2		37,735	16.7		5.2
— Road — Business	2,428	1.9		8,904	3.9		11.4
— Rail	6,784	5.4		4,791	2.1		(2.9)
— Air	627	0.5		3,551	1.6		15.5
— Marine	—	—		2	—		—
Transportation Total	30,315		24.0	54,983		24.3	5.1
Total Final Energy Consumption	126,275		100.0	226,155		100.0	5.0

Source: **Saskatchewan Energy Flow Accounts**,
Department of Mineral Resources,
February, 1977.

Columns may not add up to totals, due to rounding.

Table 2-5
Saskatchewan Final Energy Consumption By Energy Commodity, 1963 and 1975

Energy Commodity	1963		1975		Compound Annual Rate of Increase (Decrease) (%)
	(MMM BTU's)	(% Share)	(MMM BTU's)	(% Share)	
Coal	4,354	3.4	1,459	0.6	(8.7)
Electricity	7,663	6.1	21,410	9.5	8.9
Natural Gas	29,431	23.3	82,957	36.7	9.0
— Motor Gas	45,655	36.2	66,620	29.5	3.2
— Diesel Fuel	16,735	13.3	31,954	14.1	5.5
— Kerosene	6,656	5.3	8,394	3.7	2.0
— Light Fuel	9,668	7.7	8,454	3.7	(1.1)
— Heavy Fuel	5,487	4.3	1,357	0.6	(11.0)
— Aviation Gas	340	0.3	642	0.3	5.4
— Aviation Turbo	288	0.2	2,909	1.3	21.3
(Energy) RPP Total	84,829	67.2	120,330	53.2	3.0
Total Final Energy	126,276	100.0	226,156	100.0	5.0
Consumption					

Source: **Saskatchewan Energy Flow Accounts**,
Department of Mineral Resources,
February, 1977

Columns may not add up to totals, due to rounding

Figure 2-2

SASKATCHEWAN FINAL ENERGY CONSUMPTION BY END-USE CATEGORY 1963-1975

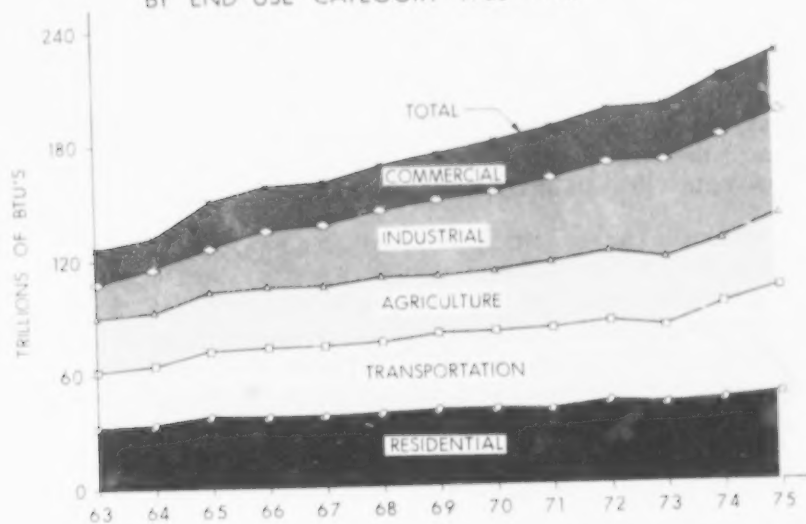
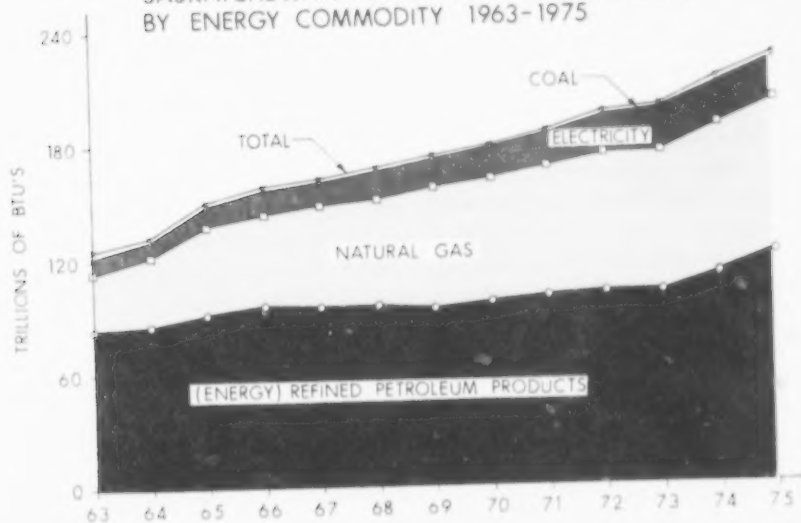


Figure 2-3

SASKATCHEWAN FINAL ENERGY CONSUMPTION BY ENERGY COMMODITY 1963-1975



Source: Same as Table 2-3

Industrial Total

The "industrial total" demand for energy is the sum of the demands in the goods-producing industries, broken down here into agriculture, mining and smelting, and manufacturing. Energy demand in these sectors is determined largely by the level of production, the degree of capital intensity (or mechanization), and the level of energy-efficiency. Each sector, nevertheless, has distinctive aspects and is treated individually. Energy consumption in the Industrial sector grew at a faster rate (6.1%) than total energy consumption (5%). Its share of total consumption expanded from 36% to 41%.

Agriculture

The major factor which determines the demand for energy in the agricultural sector is the degree of farm mechanization. Because most of the machinery is used in mobile operations, the demand is met almost totally by portable petroleum fuels — motor gasoline and diesel fuel oil. While agriculture remains the most important sector in the Saskatchewan economy, and consumes the largest proportion of energy after the residential sector, its demand has increased at little more than half the rate of total energy consumption. Agriculture's share of total energy consumption consequently decreased from 22% to 17% during 1963 to 1975.

Mining and Smelting

As a result of the major expansion of Saskatchewan's mineral industry (particulary potash) since 1963, this sector's consumption of energy has increased at almost 3 times the rate of total energy consumption. Similarly, its share of demand has almost tripled to 13% of the total. About three-quarters of the mining and smelting sector's energy requirements are met by natural gas, with electricity making up most of the remainder.

Manufacturing

The rate of increase in energy consumption in the manufacturing sector, while less than half that of mining and smelting, exceeded the growth rate of total energy consumption by a significant amount. By 1975, its share of total energy consumption had risen to almost 11%. About half of this sector's energy requirements were met in 1975 by natural gas and another 20% by diesel fuel, with the balance of the requirements met by six other types of energy.

Commercial

The commercial sector, like the residential sector, requires most of its energy for space-heating purposes. The growth rate of energy consumption in this sector was similar to that of total energy consumption, with a share of total energy consumption of 13.5% in 1975. The major source of energy is natural gas, which supplied about three-quarters of total energy requirements.

Transportation

The demand for energy in the transportation sector reflects the demand for different modes of transport (road-personal, road-business, rail, air and marine). Overall, this sector grew at the same rate as total energy consumption. The unique feature of this sector is its complete dependence on portable fuels (essentially refined petroleum products — in particular, gasoline and diesel fuel oil).

Road-Personal

The importance of the private automobile in the total demand for energy cannot be overemphasized. While the rate of increase in energy consumption for this purpose has paralleled that of total energy consumption, this sector's share of total consumption (almost 17%) is lower than that of only 2 other end-use categories — residential and agriculture. Moreover, private automobile transport is uniquely dependent on only one fuel — motor gasoline.

Road-Business

While the road-business sector accounted for only 4% of total energy consumption in 1975, it grew at more than twice the rate of total consumption during 1963-75. A major factor in the demand for energy in this end-use sector is the increased emphasis on trucking in the province as a result of declining rail transport. The energy requirements of the road-business category are met largely by diesel fuel, with the remainder supplied in the form of motor gasoline.

Rail

As a result of the decline in rail transport in Saskatchewan, this is the only end-use sector to experience a drop in the consumption of energy. In 1975, it accounted for only 2% of total energy consumption, and obtained almost all of its energy requirements in the form of diesel fuel.

Air

The growing importance of air transport in the province is reflected in the growth of this sector's energy consumption at a rate three times that of total energy consumption. The air sector nevertheless represents the second smallest level of energy consumption of all the end-use categories.

Marine

The demand for energy in the marine category is almost negligible, due to the fact that Saskatchewan is land-locked and lacks any significant water systems. Demand in this sector can be attributed largely to the use of pleasure craft.

Total Energy Consumption

It is not yet possible to provide a definitive explanation of the increase in total energy consumption, 1963-1975, of 79%. This represents a compound rate of growth of 5% per year. A detailed investigation of the reasons for changes in energy consumption is related to the topic of energy forecasting, which is discussed at the end of this chapter. A few general comments, however, can be made.

It is clear that population growth in the province during 1963-75 was not the reason for the increase in energy consumption, since Saskatchewan's population actually declined from 933 thousand to 907 thousand during the period. One likely major reason for the increase, however, is the fact that (except for the last two years of this period) the prices of energy commodities declined in comparison to the prices of other goods.

In Canada, for example, the average cost of energy to individual consumers decreased by about 20 per cent relative to the Consumer Price Index between 1961 and 1970. In the face of lower relative prices for energy, it is understandable that businesses and consumers would consume greater quantities of (what was at the time) a relatively cheaper commodity.

A second likely major reason for greater energy consumption during this period was that Saskatchewan industries produced more goods and services in 1975 than in 1963. The province's Gross Domestic Product, measured in real terms (in this case, 1961 dollars), rose from \$2,270 million to \$3,084 million — an increase of 36%. Given this expansion of real economic activity, it is understandable that Saskatchewan industry would increase its consumption of (what was at the time) "cheap" energy.

Table 2-4 indicates that energy consumption for business purposes (i.e., excluding the Residential and Road-Personal sectors) rose from 73 trillion BTU's in 1963 to 141 trillion BTU's in 1975 — an increase of 93% or a compound rate of growth of 5.65% per year. Thus, on average over the period, a 1% increase in real Gross Domestic Product resulted in a 2.6% increase in energy consumption by business (i.e., a 93% increase in business energy consumption divided by a 36% increase in real economic production). Not only did Saskatchewan industry on average grow over the period and therefore consume additional energy, it also became more "energy-intensive" in its production of goods and services.

Third, there is the fact that the standard of living (real income) of Saskatchewan residents increased over the period. With higher real incomes, it is likely that consumers would purchase additional consumer goods or appliances which require energy for their use (i.e., houses, cars, power lawn mowers, etc.). During the period 1963-1975, personal disposable income in Saskatchewan, measured in real terms (i.e., after allowing for inflation) increased by approximately 83 per cent. During the same time, total provincial direct purchases of energy for "personal" (i.e., non-business) purposes increased from 53 trillion BTU's to 86 trillion BTU's — an increase of 62% representing a compound growth rate of 4.1% per year. On average, therefore, for every 1% increase in real disposable income, Saskatchewan consumers increased their direct purchases of energy by about 0.75% (i.e., a 62% increase in direct personal expenditures on energy divided by an 83% increase in real personal disposable income).

While industry's production of goods and services became more "energy-intensive" during 1963-75, there was a decrease in the portion of consumer income devoted to the direct purchase of energy. Both business and consumers, however, increased their consumption of energy at substantial rates — 5.7% and 4.1% respectively — resulting in a total growth of energy consumption of 5% per year.

Forecasting Energy Demand and Supply

The foregoing discussion has outlined and roughly explained previous changes in the pattern of energy consumption and production in the province. Understanding Saskatchewan's "energy system" sufficiently well to be able to forecast future changes with reasonable accuracy, however, is a much more demanding task. The benefits of being able to prepare reliable forecasts, nevertheless, are substantial and include the following:

1. an improved understanding of the factors which influence demand and supply, in order to better manage the "energy system"; and

2. anticipation of, and therefore a longer time in which to prepare preventive measures in respect of, any imbalances in energy demand and supply.

At the present time, demand and supply forecasts are prepared in respect of particular energy commodities by different Provincial agencies. As an integral part of its responsibility to meet the electrical and natural gas requirements of Saskatchewan residents, the Saskatchewan Power Corporation annually prepares and publishes from time to time ten to twenty year forecasts of provincial consumption and production of these energy commodities. The Department of Mineral Resources published in 1976 its first 20-year forecast of provincial oil reserves and production capability. The Department is also developing, in conjunction with the Saskatchewan Bureau of Statistics, a system to forecast the consumption of refined petroleum products on the basis of the 10 end-use categories outlined in this chapter.

Chapter 3

Energy Conservation

Introduction

Chapter 2 outlined the amount of energy utilized in Saskatchewan, and indicated the substantial increase in energy consumption since 1963. It also pointed out that such increases did not result from population increases but largely from an expanded per capita utilization of energy for personal and business purposes. The aim of this chapter is to explain the need to reduce the growth rate in energy consumption and to outline the measures which the Government has taken and those which it is considering to bring about this reduction.

Saskatchewan's energy conservation measures are designed to reduce the economic, environmental and social costs of energy consumption. The economic costs of energy consumption follow from the fact that energy is becoming more scarce and more expensive to produce. There was a period when production for bigger and bigger markets led to reductions in unit costs to the energy user. This certainly was the case when the provision of electric power was brought under the jurisdiction of the Saskatchewan Power Corporation, and it also applies to some extent to the utilization of larger pipelines to transport oil and natural gas.

Those days of cheap energy, however, are over. The cheaper supplies of energy have been used up and additional supplies have to be obtained by drilling and digging deeper underground, by converting energy from one form to another (such as from coal to natural gas) or by seeking out new sources which are further from energy markets.

It is estimated that Saskatchewan residents spent \$590 million in 1975 for business and personal final consumption of energy commodities. This represents 8.8% of Saskatchewan's Gross Domestic Product (GDP) for that year. Moreover, if energy prices continue to rise faster than the prices of other goods and the annual rate of growth in energy consumption continues at a faster rate than real GDP (5% versus 2.4% during 1963-1975), energy expenditures as a proportion of GDP will continue to increase. Furthermore, the above estimate excludes investment expenditures on energy supplies which are also growing and must be supported by the economy.

Even if energy consumption does not increase beyond the current level, the existing level of demand will require the continued production of increasingly expensive non-renewable resources. If energy consumption continues to increase, however, this will mean ever greater capital outlays to invest in energy supplies, and higher prices to the consumer and to business for the energy which they utilize.

These trends, therefore, represent the economic rationale for energy conservation—the need to minimize personal and business expenditures on energy and to use these funds for other important purposes. Furthermore, in a number of areas, it is now more economic to invest in measures to conserve energy (e.g., better insulation of buildings) than to invest in measures to obtain additional energy supplies.

The environmental need to conserve energy arises from the pollution which results from both the production and the consumption of energy. As outlined in more detail in Chapter 7, energy activities and the environment are intimately related. Historically, energy development has often been at the expense of the environment. While Chapter 7 outlines the ways in which Saskatchewan is acting to minimize this potential conflict, a complementary approach is that of reducing the demand for energy. To the extent that these efforts are successful, the "energy-environment conflict" can be minimized.

The social rationale for conserving energy arises from the need to minimize the disruption which would arise from imbalances between energy demands and supplies (e.g., the disruption which would result from energy rationing). Over the coming decades, as the world's and Canada's supplies of crude oil and natural gas become more difficult and more expensive to obtain, steps will have to be taken to reduce the tremendous extent to which energy demands are met from these two non-renewable energy sources. To the extent that energy consumption can be minimized, there will be additional time to plan for and to implement the necessary transition toward a greater reliance upon renewable, and more abundant non-renewable, sources of energy.

For these reasons, the Saskatchewan Government strongly supports the objective of energy conservation and has taken a number of measures to this end. In December, 1975, the Province formally established its Energy Conservation Program. One objective of the Program is to encourage the public to conserve energy, by means of information programs and the establishment of incentives and disincentives related to energy consumption. A second objective is to advise the Government on the means by which it can reduce its own consumption of energy.

The Program is based on a broad definition of energy conservation—namely, “to make the most efficient and effective use of energy resources”. More specifically, this definition comprises 3 interrelated aspects, as follows:

1. to increase the efficiency by which energy is recovered, converted and used;
2. to reduce the demand for energy by modifying “lifestyles”;
3. to adopt the best end-use for a particular resource.

These energy conservation concepts of efficiency, demand and end-use are important because they assist, for policy-making purposes, in separating out the issues of mechanical efficiency, human lifestyles and the best use of particular energy resources when people and machines interact.

The Energy Conservation Program has been directed by the Policy Planning and Research Branch, Department of Mineral Resources. Rather than relying only on “in-house” expertise, and in order to involve as many Government agencies as possible, the Program involves representation from 27 Government agencies and crown corporations. Their efforts are organized in terms of 5 major subject areas, for each of which a special technical committee of government officials was established, as follows:

1. Agriculture
2. Buildings
3. Industry
4. Transportation
5. Information/Education

Some of the more important measures which have been taken or are being considered under the Energy Conservation Program are outlined below.

Agriculture

The agricultural sector of the Saskatchewan economy is a major energy consumer, and is particularly dependent upon refined petroleum products. While further energy savings can be made in respect of space-heating on the farm, it will prove more difficult to achieve similar energy and dollar savings in other types of energy used on the farm. These other types of energy demand depend upon farming practices, the technology of farm machinery, and the requirement for other types of energy inputs such as fertilizers and pesticides.

Energy conservation measures which have been taken in the agricultural sector include: the provision of information by the provincial Department of Agriculture regarding good farming practices and the optimum use of all resources, including energy; the provision of advice by SPC on the efficient use of energy in farm operations; and the provision of information by the Prairie Agricultural Machinery Institute regarding the energy efficiency of farm machinery. The Energy Conservation Program is currently conducting research into the relationship between energy use and prevailing farm practices, as well as exploring the use of waste heat and solar energy for grain drying and greenhouse purposes.

Buildings

The consumption of energy for heating and cooling buildings is the largest area in which important results can be achieved relatively quickly. Major emphasis, therefore, has been placed on reducing energy use in both public and private buildings. Some of the major measures undertaken to date are:

1. higher insulation standards for all new Government-owned or Government-financed buildings (for example, offices, schools, hospitals);
2. the distribution of a model bylaw regarding higher insulation standards to all municipalities by the Department of Municipal Affairs;
3. based on a computerized analysis of energy flows in buildings, the Department of Government Services established a target of reducing energy consumption in Government buildings by 11% in 1976-77, with further savings expected in subsequent years;
4. several crown corporations have taken steps to reduce their energy requirements for heating, cooling and lighting existing buildings;
5. the Conservation Program is reviewing the adoption of a provincial building code which would incorporate minimum thermal performance standards for all new buildings in Saskatchewan.

Industry

The Government has an important role in helping to achieve energy savings in the industrial sector. Given that the manner of energy use is often unique to particular processes, however, each industry has to assume a large responsibility for identifying and implementing energy conservation measures appropriate to its circumstances.

The Saskatchewan Power Corporation has provided advice for many years to industry on the efficient use of electricity and the optimum sizing of electrical equipment. The Conservation Program has contacted various industrial associations to assist in determining appropriate cost-effective energy conservation measures. Further measures being considered under the Program include: the establishment of a mobile consultant/computer analysis service available to industry to assist in identifying areas of energy and dollar savings; and, information and incentives to industries to increase their efficiency of energy use and alter their fuel supply from a relatively scarce natural resource like natural gas to a more plentiful one like Saskatchewan lignite coal.

Transportation

In order to conserve energy use in the transportation sector, the Conservation Program's objectives are:

1. to encourage more passengers to use more energy-efficient vehicles;
2. to reduce average highway speeds; and
3. to increase average urban speeds through less stopping and starting.

The major areas of action taken to date are as follows:

1. the encouragement of public transit in urban areas;
2. a reduction in the proportion of big cars in the Government's vehicle fleet;
3. the establishment of lower speed limits on highways as of September 1, 1977;
4. discussion with the larger cities in the province regarding the possible establishment of computer-based traffic control.

Information/Education

Public information and education on energy conservation are regarded as critical to the success of the Conservation Program. While an extensive public information program will influence the amounts and efficiency by which energy is used, the introduction of energy conservation ideas into school programs will lay the foundation for new perceptions and attitudes toward energy use. The following measures are examples of the major steps which have been taken under this part of the Program:

1. 300,000 copies of various publications on energy conservation have been made available to the public through teachers, libraries and municipal offices;
2. the Department of Education is examining possible means of formally introducing the concept of energy conservation into school programs and curricula.

Office of Energy Conservation

On November 16, 1977 the Provincial Government announced the establishment of an Office of Energy Conservation. This Office, reporting to the Minister of Mineral Resources, will assume responsibility for the Energy Conservation Program and will operate a number of significant new programs. One of the most important new initiatives is an energy saver loan program which will be offered to homeowners beginning in 1978. Other major initiatives will be announced during the year.

Chapter 4

Security of Energy Supply

Introduction

The achievement of "security of energy supply" has traditionally involved only the obtaining of sufficient supplies of energy at reasonable (i.e., low) prices. In today's circumstances, however, such a strategy is incomplete. In Chapter 3, it was pointed out that in many instances it may be easier and more economic to reduce energy demands than to supplement energy supplies, in the process of ensuring that our energy demands and supplies are in appropriate balance. Chapter 5 includes a discussion of the pricing of energy to the Saskatchewan consumer, Chapter 8 provides an outline of Saskatchewan's energy research and development activities, many of which will have an impact on the province's security of energy supply. The purpose of this chapter is to outline the other practices which Saskatchewan is employing to ensure a secure supply of energy at a reasonable cost for the residents of the province. These include resource development planning and pricing, legislation and regulations, crown corporation investment and production, and export controls.

Saskatchewan's Energy Reserves and Receipts

Saskatchewan is relatively fortunate in terms of its energy resource base. While the province's resources are not so large as to be a major factor in meeting Canadian energy demands over the longer term, they (and prospective energy imports where required) are adequate to meet the needs of Saskatchewan residents for many years to come.

Table 4-1 provides an estimate of Saskatchewan's energy resources which are demonstrated, and technically and economically recoverable under current and near-term conditions. They include both reserves of non-renewable energy and receipts of renewable energy. The estimate of renewable energy receipts pertains only to hydraulic energy. Reasonable estimates of solar, wind, biomass and geothermal energy receipts which are "demonstrated, and technically and economically recoverable under current and near term conditions" are not yet available for Saskatchewan. Since the potential of these energy resources is becoming more important, however, the Government is becoming involved in determining their likely magnitude.

Table 4-1

An Estimate of Saskatchewan's Energy Reserves and Receipts

Energy Commodity	Reserves/Receipts (natural units)	(MMMM BTU's)	Con- version Factor	Useful Energy (MMMM BTU's)	Percentage of Total Useful Energy
Non-Renewable					
1. Natural Gas (Bcf)	782	782	1.00	782	1.9
2. Crude Oil (MMbbls)	673	3,903	1.00	3,903	9.7
3. Uranium (MMlbs U ₃ O ₈)	195	39,000	.30	11,700	28.9
4. Coal (MMtons)	4,500	59,400	.40	23,760	58.7
Subtotal		103,293		40,145	99.2
Renewable					
5. Hydro:					
— annual (MMKwh/yr)	1,800				
— 50 years (MMKwh)	90,000	307	1.00	307	0.8
Total		103,600		40,452	100.0

Note: The estimates of remaining reserves of natural gas and crude oil are as of year-end 1976. Renewable energy receipts, in the form of hydroelectricity, refer only to the average capacity of existing SPC dams (which represent about 17% of potential hydroelectric capacity). The reference for the uranium conversion factor is Atomic Energy of Canada Ltd., **Candu 600 Station Design**.

While it is always difficult to compare quantities of non-renewable energy (i.e., a stock of minerals measured at a point in time) and renewable energy (which is measured in terms of receipts over time), a comparison is made herein by multiplying the annual renewable energy receipts (of hydroelectricity) by a factor of 50.

Table 4-1 also provides an estimate of the useful energy which can be obtained from each primary energy source. While the "Conversion Factor" used to make this estimate does not take account of the relatively small quantities of energy used in pumping, mining, cleaning, transporting or refining the primary energy, it does take account of the very substantial losses of energy when coal or uranium are transformed into useable forms of energy.

In the case of uranium, the only potentially useful form would be electricity, and the conversion factor for this fuel source reflects the conversion loss in nuclear power plants. In the case of coal, there are many potential applications of this primary energy source (e.g., electrical generation, substitute natural gas, synthetic liquid fuels, burning raw coal). The conversion factor applied to coal in Table 4-1 is based on the assumption that a large percentage of Saskatchewan's lignite coal would be converted into electricity (conversion factor of 0.30) and substitute natural gas (conversion factor of 0.60 to 0.70).

Crude Oil and Refined Petroleum Products

At the present time, about one half of Saskatchewan's energy consumption is met by refined petroleum products. While part of this is supplied by Alberta-based refineries, it is expected that a greater proportion of these products will be refined within Saskatchewan in the near future.

Almost all of the crude oil feedstock for Saskatchewan's refining capacity is imported from Alberta. This follows largely from the fact that Saskatchewan crude is generally of a heavier gravity and, for the most part, cannot be refined by normal procedures into the types of products which are required by Saskatchewan or Canadian consumers. Discussions with industry and the federal and Alberta Governments are currently underway to explore the possibility of establishing an upgrading facility in Saskatchewan. Such a facility would "pre-refine" these heavy crude oils to a quality suitable for refinement into useable petroleum products.

Alberta crude will presumably be reserved in the future first for consumption in Alberta, second for consumption in Canada, and third for consumption outside of Canada. Since most of Alberta's crude oil flows east rather than west, Saskatchewan should rank pretty closely after Alberta as

the next most important market for this oil. The National Energy Board forecasts that, in 1995, Alberta will still be producing roughly three times the amount of oil which she will need herself. It would seem to follow that, short of Canada-wide allocation measures in the event of an international emergency, Saskatchewan consumers can expect to have reasonable access to oil supplies from Alberta for many years to come.

Natural Gas

Natural gas consumption in Saskatchewan is second only to that of refined petroleum products, and currently accounts for almost 40% of total provincial energy consumption (excluding natural gas consumption by TransCanada Pipeline Ltd.). Saskatchewan's proven reserves of 782 billion cubic feet (Bcf) and probable reserves of about 1200 Bcf (as of year-end 1976) represent less than 18 years of forecast cumulative provincial consumption. For this reason, Saskatchewan has had a long-standing practice of not authorizing the removal or export of natural gas from the province (the only exception to this practice is one Export Permit, issued in 1965, which provides for the export of relatively small amounts of gas).

In the fall of 1976, Saskatchewan formalized its policy on the export of natural gas by adopting a Gas Removal Formula which compares the deliverability of proven and (one-half of) probable reserves of gas to estimated provincial requirements over the next 10 years. Application of this formula (which is similar to formulas employed by Alberta and the National Energy Board) indicates that, in the absence of any phenomenal increase in proven and probable gas reserves, Saskatchewan will not be in a position to allow the removal of natural gas from the province.

Since the 1950's, the Saskatchewan Power Corporation has carried out the responsibility of securing and delivering sufficient supplies of natural gas to meet the needs of Saskatchewan consumers. Because of limited natural gas resources in the province, the Corporation has obtained its supplies from Alberta as well as Saskatchewan. By means of exploration, development and production in its own right and with other companies, and by entering into purchase contracts with other gas producers, SPC continually ensures a supply of gas sufficient to meet future provincial requirements for many years.

The Government's planning to meet the future gas requirements of the province takes into account the likelihood that the availability of natural gas from Alberta to meet Saskatchewan's requirements may begin to decrease in the later 1980's. The establishment of The Natural Gas Development and Conservation Board was announced in the fall of 1976 to consider possible increases in the production of natural gas from provincial reserves. The

Board held a public hearing on this and other matters in October, 1977, and will make recommendations to the Minister of Mineral Resources regarding appropriate fieldgate prices and scheduling of the development of natural gas production in the province. An increase of about 30% in the average fieldgate price for natural gas produced in the province was announced in December, 1976.

Further natural gas options being considered by the Government include the possibility of converting the substantial provincial supplies of lignite coal into substitute natural gas, and importing natural gas from northern Canada if and when gas from this region becomes available.

Electricity

Electricity represents the third source of energy for Saskatchewan consumers. During the 1950's and 1960's, the Saskatchewan Power Corporation assumed an increasing responsibility for meeting Saskatchewan's electrical requirements, both by purchasing privately-owned generation sources and by expanding its generation facilities and transmission network throughout the province. Today, the Corporation is responsible for meeting almost all of provincial demand and its services are available to almost every resident in the province. Through its responsibility to meet the combined electrical needs of Saskatchewan residents, this crown corporation has vastly improved the security of electrical supply for Saskatchewan consumers.

SPC obtains electricity from four different sources: coal-and gas-fired thermal power plants, hydroelectricity, and imports from Manitoba. The vast majority of the Corporation's electricity is derived from Saskatchewan coal and Saskatchewan hydro. The security of supply of Saskatchewan coal is discussed below, while that of hydroelectricity (being a renewable source of energy) is well ensured. In the case of imports from Manitoba in some years, the Corporation has had an arrangement with Manitoba Hydro since the 1960's whereby they would exchange power on a daily basis in accordance with the prevailing lowest-cost source. While these arrangements do not provide for long-term imports or exports of power, they have resulted in a lower cost of electricity to Saskatchewan residents and a strengthened standby capacity in case of emergencies.

Coal

Saskatchewan's large reserves of lignite coal provide the major source of energy for electrical generation. As outlined in Table 4-1, these reserves of lignite represent the largest single source of energy in the province. They are also the most versatile of energy fuels, in that coal can be burned

directly to produce heat or converted into any of the 3 major forms in which energy is utilized in Saskatchewan—namely, petroleum products, natural gas and electricity. In view of the importance of this major energy resource, the Government has taken several steps to ensure its orderly and secure development for the residents of the province.

In 1972, the Province undertook with the federal Government a study to evaluate the quantity and quality of Saskatchewan's coal resources. Final results from this evaluation are expected in 1978. Second, in 1973 the Government placed a moratorium on new coal permits in order to ensure that Crown coal reserves would not be completely allocated and, therefore, that development options would remain open. Third, in 1976 the Legislature passed the Coal Conservation Act which provides for regulations for the orderly development of these coal resources. Fourth, in 1977 the Government completed a coal development study, which provides background information on a number of important subjects such as Saskatchewan's coal resource base and security of energy supply for the province. Fifth, the Department of Mineral Resources has begun work on the many issues to be covered by a Coal Policy, which is expected to be completed by mid-1978.

As a result of these measures, the Government will ensure that this major energy resource will be developed in the most appropriate manner to meet the long-term energy requirements of Saskatchewan residents and to confer the greatest benefits on the province as a whole.

Uranium

Saskatchewan's fifth energy resource—uranium—enters into the production but not the consumption side of the provincial energy equation. Its contribution to Saskatchewan is of an economic nature—as outlined in Chapter 5 (Economic Benefits from Energy Resources). Uranium represents a potential energy source, however, should the Province decide to utilize nuclear power in later decades. The expanding proven reserves of this energy source, achieved in part because of the activities of the Saskatchewan Mining Development Corporation (SMDC), ensure that Saskatchewan retains a secure supply of this energy fuel should its utilization in the province become desirable or necessary.

Chapter 5

Economic Benefits From Energy Resources

Introduction

As outlined in other chapters, provincial energy resources contribute significantly in meeting the energy needs of Saskatchewan residents. Of further advantage, however, are the economic benefits which accrue to the people of the province from the development of these resources.

These benefits take the form of: lower energy costs to the consumer (who does not have to pay for transporting these fuels into the province); employment opportunities; purchases in Saskatchewan by energy industries; profits to Saskatchewan owners of energy companies; and public revenues from the payment of royalties and income taxes. Except for economic benefits from public revenues (which is discussed in Chapter 6), these sources of benefit are discussed in the remainder of this chapter under the following headings: Value of Saskatchewan's Energy Reserves; Production; Pricing; Resource Upgrading; and Resource Ownership.

Value of Saskatchewan's Energy Reserves

A rough measure of the economic importance of Saskatchewan's energy reserves is outlined in Table 5-1. This indicates that the "valuation" (at current market values) of provincial energy reserves is about \$30 billion. While this valuation will vary with changes in reserves and energy prices, it represents an approximate measure of the value to Saskatchewan if all of these energy reserves were produced over many decades in the future. Moreover, this valuation excludes the additional economic benefits which would accrue from further processing of these resources in the province.

The ultimate benefit to Saskatchewan residents (in the form of direct income) of the production of these energy reserves depends on the subsequent distribution of the \$30 billion sales revenue in the form of: payment of salaries and wages to Saskatchewan workers; purchases of materials and equipment from Saskatchewan industries; public revenues in the form of royalties and provincial income taxes; and profits to Saskatchewan shareholders of the energy supply industries.

Table 5-1
Estimated Current Market Value of Saskatchewan's Energy Reserves

Energy Mineral	Estimated Reserves (<i>natural units</i>)	Current Market Value (<i>\$/unit</i>)	Current Valuation (<i>\$millions</i>)	Per Cent of Total Valuation
1. Natural Gas	782 MMMcf	1.20/Mcf	938	3
2. Crude Oil	673 MMbbls	10.00/bbl	6,730	22
3. Uranium (U_3O_8)	195 MMlbs	40.00/lb	7,800	26
4. Coal	4,500 MMtons	3.25/ton	14,625	49
Total			30,093	100

Notes:

1. See Table 4-1 for comment on reserve estimates.
2. It is recognized that current market values will tend to increase in the future.
3. Current valuation equals estimated reserves times current market value.

Production

Energy resource production is the prerequisite to any of the economic benefits outlined above. The achievement of these economic benefits must be balanced, however, against the social and environmental aspects of energy resource management. Since the social aspects largely relate to the goal of energy supply security, this means that economic benefits today (from energy production) must be balanced against energy security benefits in the future.

While energy security is of greater importance in the case of natural gas, the provincial supply of which is relatively small, it is of lesser importance in the case of coal, uranium and crude oil. The current ratio of economic, assured and recoverable coal supplies to the level of production per year is about 750 to 1. There is no foreseeable demand for uranium in the province. As explained in Chapter 4, the majority of Saskatchewan's crude oil is heavy gravity and cannot currently be utilized by Saskatchewan refineries or residents. In the case of these three energy minerals, therefore, economic benefits can be secured from production of the resource without too much of an impact on the security of Saskatchewan's energy supplies.

The further development of provincial crude oil resources has been enhanced by several measures undertaken by the Government. Under the Province's oil revenue system, oil companies are allowed a rebate on royalties or taxes provided that they undertake further exploration in the province. The Government has also channeled funds directly into oil exploration and development in the province, through the Saskatchewan Oil and Gas Corporation. Third, by means of representations to the National Energy Board and other federal Government agencies, the Province has made recommendations to ensure stable markets for Saskatchewan crude oil production.

In the case of uranium, the Government has invested directly through the Saskatchewan Mining Development Corporation in exploration for this energy resource.

Increased coal production will depend upon developing markets as the importance of this energy resource receives greater attention. For example, as a result of SPC's Poplar River electric generating plant coming on stream in 1979, annual coal production will increase by 2 million tons or about 30 per cent.

Pricing

The purpose of this section is to outline, for each of the energy sources, the nature of the pricing system and the Government's role in that system as

it affects the Saskatchewan resident in his or her capacity as an energy consumer and as an owner of energy resources.

The economic implications of the price of energy resources depend upon whether Saskatchewan is importing or exporting the energy fuel or simply producing it for use within the province. In the case of energy imports to Saskatchewan, it is in the economic interest of the residents of the province to have a lower price to pay (as long as the security of supply of those fuel imports is not weakened). Conversely, if provincial resources are being produced for export out of Saskatchewan, it is in the province's economic interest to have as high a price as possible to receive for the sale of these resources (as long as these products are not priced out of the market).

Finally, where provincial energy resources are produced for consumption within Saskatchewan only, there is a greater degree of possible choice since higher prices to the provincial consumer largely result in higher revenues to the provincial treasury (through higher royalties) while lower prices (and lower royalties and benefits to the taxpayer) result in lower costs to the consumer. The appropriate pricing objective, therefore, depends upon the particular energy transaction or situation.

The concept of economic benefits to Saskatchewan consumers through lower energy prices raises the issue of appropriate pricing to achieve the objective of energy conservation (since a higher price for an energy commodity often results in a lower consumption of that commodity). While these two objectives (low energy costs and low energy consumption) are sometimes difficult to reconcile in practice, there need not necessarily be a conflict between them.

To obtain energy imports for Saskatchewan at the lowest cost results in an economic benefit. It need not necessarily result, however, in lower energy prices to the consumer. If, for example, it is decided that higher energy prices are required to help achieve greater energy conservation, this can be achieved through taxes on energy consumption, with the tax revenue redistributed to Saskatchewan residents through lower taxes in other areas (e.g., income or sales tax). The objective of obtaining energy imports at a low cost does not necessarily mean that such low costs have to be passed on to the consumer in the form of low energy prices. The economic benefits to the province of low-cost energy can be distributed to Saskatchewan residents through a variety of fiscal measures. The securing of low cost energy, therefore, remains a valid economic objective.

Oil

Since the fall of 1973, the price of oil sold in Canada has been established by the federal Government in consultation with the provinces. Since Saskatchewan produces about three times as much oil as it consumes (in refined petroleum products), it is in Saskatchewan's interest to achieve a higher price for this energy resource. The federal Government, however, has held the national price below the international price for oil since 1973.

Saskatchewan's economic loss in respect of crude oil production as a result of the federal Government's two-price system for oil is outlined in Table 5-2 and Figure 5-1. This Table also indicates the economic loss to the province of the federal Government's security of oil supply policy, whereby exports have been reduced (and "shut-in" oil capacity has resulted) in order to safeguard Western Canadian oil supplies for future use in Canada.

As indicated in column 5 of the Table, the crude oil production revenue foregone by the Saskatchewan economy as a result of the lower price has totalled \$825 million to year-end 1976. Column 6 outlines the revenue foregone by Saskatchewan as a result of "shut-in" oil capacity from 1974 to the end of 1976—a total of \$469 million. The final column indicates the total additional crude oil production revenue which the province would have received to the end of 1976 if neither prices nor markets had been restricted, a cumulative total of \$1,294 million.

This estimate of the loss to Saskatchewan crude oil production is overstated in that it does not take account of the fact that equalization payments to Saskatchewan from the federal Government are higher as a result of this economic loss. The difference in the equalization payments, however, is a relatively small proportion of the estimated economic loss. Since the majority of this additional oil revenue would have accrued to the Provincial treasury, it represents a (somewhat overstated) measure of the loss to every taxpayer in the province.

While Saskatchewan supports the concept of security of oil supply for Canada and appreciates the desire for a gradual increase to international oil prices, the Provincial Government has objected to the disproportionate share of the economic costs which Saskatchewan has had to pay as a result of these federal measures, particularly since a large proportion of Saskatchewan's crude oil cannot currently be used in Canada in any case.

Saskatchewan's position on the question of crude oil pricing has been consistent in each of the annual federal-provincial conferences on this matter. The Province's position is that, if crude oil is to be singled out as a commodity whose price is to be depressed below world market levels, there should be off-setting measures so as not to discriminate against an oil-producing province.

Table 5-2
Estimated Economic Loss to Saskatchewan Crude Oil Production
From
Federal Policies on Crude Oil Pricing and Export Restriction, 1973-76

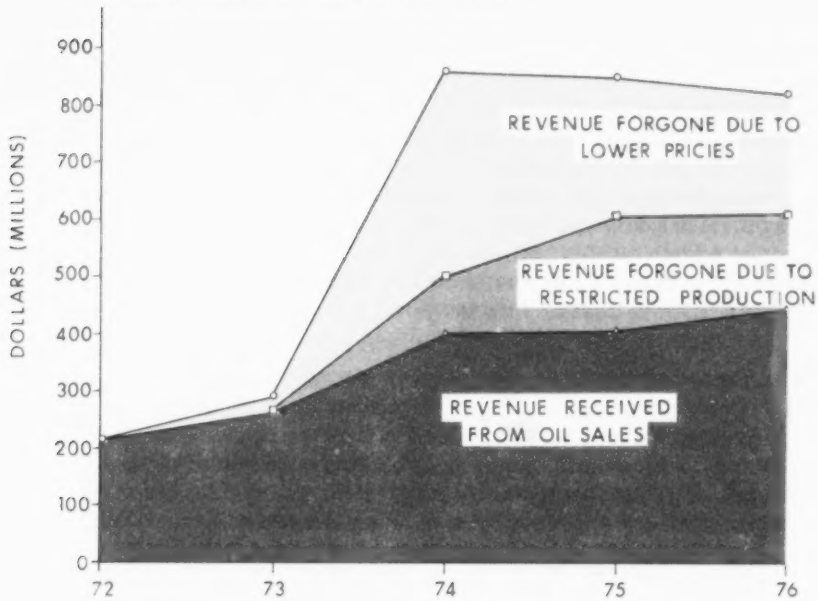
Calendar Year	(1) Actual Production (Millions of barrels)	(2) Estimated Capable Production	(3) Actual Average Wellhead Price (dollars per barrel)	(4) International Equivalent Wellhead Price	(5) Revenue Foregone Due to Lower Price	(6) Revenue Foregone Due to Restricted Production	(7) Total Revenue Foregone Due to Lower Price and Lower Production
1973	85.8	86.1	3.08	3.31	19.7	1.0	20.7
1974	74.0	84.0	5.36	10.24	361.1	102.4	463.5
1975	59.0	77.0	6.88	11.00	243.1	198.0	441.1
1976	55.9	70.5	7.90	11.50	201.2	167.9	369.1
Total	274.7	317.6			825.1	469.3	1,294.4

Notes to Columns:

- (2) Estimate of production unrestricted by demand.
 - (3) Average price for Saskatchewan crudes, weighted by production.
 - (4) Equals weighted average Saskatchewan wellhead price plus the weighted average export tax applicable to exports of Saskatchewan crude.
 - (5) Equals actual production times the difference between international and actual prices.
 - (6) Equals the international price times the difference between actual and capable production.
 - (7) Equals the sum of figures in columns (5) and (6).
- Further Note: The above estimate does not take into account the \$27.9 million which Saskatchewan received as its share of the oil export tax revenue in respect of October, 1973 to March, 1974, inclusive.

Figure 5-1

ESTIMATED ECONOMIC LOSS TO SASKATCHEWAN
CRUDE OIL PRODUCTION FROM
FEDERAL POLICIES ON OIL PRICING AND
EXPORT RESTRICTION, 1973-1976



Source: Table 5-2

Such off-setting measures could take the form of effective assistance from the federal Government in furthering Provincial policies of establishing secondary industry in Saskatchewan, or of stabilizing farm income. Alternatively, the federal Government could extend the principle of restraining the price of oil to include other essential commodities which Saskatchewan consumers must import from eastern Canada—such as farm machinery, automobiles and building supplies (this position has been outlined at greater length in *"Why Just Oil? The Case For Extending the Equalization Principle to Other Commodities"*, Saskatchewan Government, 1973).

Natural Gas and Electricity

Saskatchewan's economic interest in the pricing of natural gas is the reverse of oil, since only a very small amount of the province's production of this energy fuel is exported and substantial imports are required to help satisfy provincial requirements. In this situation, the province's economic advantage lies in lower natural gas prices in Canada. The price of gas which is imported to the province is set by the federal Government, in consultation with the provinces, and is largely linked to the price of oil in Canada. While Saskatchewan has no choice but to pay this price in order to obtain additional supplies of gas, the fact that SPC produces some of this Alberta gas results in a lower cost for these imports than if they were all purchased from private producers in Alberta.

In the case of gas produced in the province, the fieldgate price is set by the Government and paid by SPC which acts as a purchasing agent on behalf of Saskatchewan consumers. The prices are determined on the basis of production costs (including a reasonable return on investment) and royalty levels. In recent years, this royalty has been low because Saskatchewan wellhead prices have been substantially lower than elsewhere in Canada. In order to encourage the production of gas in the province, and to reduce the implicit subsidy from the provincial taxpayer to Saskatchewan gas consumers, the Government has begun to set higher fieldgate prices and to re-examine the royalty structure on this energy resource.

The final component of the price of natural gas to the consumer is the cost incurred by SPC to transport and distribute natural gas in the province. The determination of this total cost, and the way in which it is distributed among SPC customers, applies to both natural gas and electricity and requires a separate discussion.

The Saskatchewan Power Corporation is a crown-owned corporation which operates on public utility principles. Those principles are: first, to provide services (natural gas and electricity) to its customers at the lowest

possible cost; and, second, to provide those services to residents who would not enjoy access to such public service if the Government were to rely on the private sector to provide them. This latter objective inevitably involves cross-subsidization between customers since the services provided to concentrated groups of customers close to the source of energy supply will likely cost less to provide than will services provided to a sparsely populated market located a long distance from the source of energy. This principle provides for greater equality of opportunity throughout Saskatchewan, and an adequate level of service to all residents at a reasonable cost.

Two other aspects of SPC pricing require comment. The first is that of the Corporation's rate of return on investment. This is set by the Provincial Government at a level which covers the rate of interest which SPC must pay to borrow the funds which it requires. Second, there is the matter of different prices between consumers in accordance with their level of consumption.

In general, SPC charges a lower price to those electric and gas customers which consume greater quantities of these fuels. This pricing system follows well-recognized public utility accounting principles based on economies of scale (and thus lower unit costs) in providing natural gas or electricity to larger consumers. In recent years, however, the rising cost of energy resources and generation facilities has led to a debate as to whether these traditional accounting and pricing practices tend to lead to higher total levels of consumption and higher costs for all consumers.

The Corporation has made rate changes over the last few years which meet this new concern to some extent. Since 1973, the Corporation has been raising the price of the initial volume of gas or electricity consumed per customer by smaller percentage increases than the price of additional volumes of electricity or gas consumed. The result is that the current rates have a much more gradual decline as the level of consumption per customer increases than was the case in the early 1970's. These changes in rate structures reflect SPC's emphasis on the promotion of energy conservation rather than energy consumption. Further changes of this nature in the gas and electric rate structures are being examined.

Regardless of the outcome of this current debate, however, it is clear that the establishment of the Saskatchewan Power Corporation has resulted in lower energy costs for the province as a whole over the last 25 years. By acting as a public utility on behalf of Saskatchewan energy consumers, the Corporation has achieved a co-ordinated and integrated system of production, transmission and distribution for all Saskatchewan residents. The result is the provision of natural gas and electricity to customers who would not otherwise have enjoyed these services, and at prices which reflect the lowest possible costs.

Coal and Uranium

The pricing of Saskatchewan's other energy resources—coal and uranium—is relatively straightforward. The majority of provincial coal production is purchased by SPC for use in its electrical-generating stations, at a price negotiated by SPC with the coal-producing companies. The remainder of the coal, sold for use in Saskatchewan and outside markets, is priced through negotiation between the coal companies and the particular customer.

Saskatchewan's uranium is largely sold in international markets at prices which are determined by negotiation between uranium producers and consumers. The federal Government, in approving export contracts through the Atomic Energy Control Board, ensures that the price received represents a fair value in relation to world prices for this energy commodity.

Resource Upgrading

In general, provincial energy resources can be further processed in three ways:

1. as a feedstock material, they can be converted to non-energy products (e.g., plastics manufactured from oil);
2. they can be used in new industries which locate within the province because Saskatchewan has a relatively secure supply of energy;
3. they can be converted from one form of energy into a different form (e.g., coal into substitute natural gas or electricity).

The economic benefits to Saskatchewan of upgrading these resources in the province are, with certain exceptions, similar to those outlined in respect of additional production of the resources themselves. For this reason, it is Government policy to have these resources upgraded within the province to the extent feasible. This policy is applied only in those cases where the security of supply or environmental aspects of a project are not of overriding concern.

Resource Ownership

A further means of increasing the economic benefits from provincial energy resources is to encourage the extent to which Saskatchewan residents, either directly or through crown corporations, own the energy supply industries. While information regarding direct ownership by Saskatchewan residents is not available, the presence of three energy crown corporations operating in all five energy supply industries ensures that a significant portion of resource profits accrues to Saskatchewan

residents through the Provincial treasury. As long as this type of investment yields a greater return than Government investment in other areas, Saskatchewan residents derive a net economic benefit from their ownership of some of the energy industries.

Chapter 6

Public Revenue From Energy Resources

Introduction

Public revenues currently represent one of the major economic benefits to Saskatchewan residents from energy resource development. The Saskatchewan Government's approach to public revenue from energy resources is relatively straightforward and is based on two general principles.

First, the companies developing the resources should retain sufficient revenue to cover their operating expenses and to provide a fair return on their capital investment commensurate with the risk involved. Second, the owners of the resource—through their Government—should receive any revenues in excess of those required by the producing companies (as outlined above). On the basis of these two principles, the Government has obtained a high return from its energy resources while ensuring that the energy resource industries remain in an economically viable position.

Table 6-1

Provincial Government Revenues From
Energy Resource Development, 1976-77

	(\$000's)
1. Crude Oil	\$199,612
2. Natural Gas	817
3. Coal	586
4. Uranium	431
5. Electricity (water power rental)	510
Total	\$201,956

Note: This revenue does not include provincial corporate income tax or dividends from energy crown corporations.

Table 6-1 outlines the revenue received by the Saskatchewan Government during fiscal year 1976-77 as a result of the development of the province's five energy resources. This government revenue of over \$200 million represents about 14% of the total Provincial Government revenue of \$1,429 million in 1976-77 (including the revenue from oil deposited in the Energy and Resource Development Fund).

The above figures indicate that oil production provided almost all of the public revenues from energy resource development in 1976-77. While oil will continue to dominate the energy development sources of revenue, uranium development could also become an important revenue source. The prospects for public revenues from natural gas will increase as the wellhead price is raised closer to the price paid for natural gas from other sources in Canada. Public revenues from coal will rise, as production expands and prices increase faster than costs, but the total revenue will continue to be relatively small. Revenue from water power rentals is not likely to increase substantially.

Public Revenues From Oil Resources

Given the importance of provincial public revenues from oil production, it is useful to outline in some detail the history of this revenue source. Such a history is important in view of the differences of opinion regarding appropriate oil revenue sharing among the Saskatchewan and federal Governments and the petroleum industry.

An estimate of the distribution of oil revenues during 1972-77 is provided in Table 6-2 and Figure 6-1. This indicates, in terms of a barrel of Saskatchewan oil which is exported from Canada, the major changes in the barrel's value resulting from changes in world oil prices and Canadian wellhead prices. It also outlines the changing distribution of the revenue from the barrel among the oil industry and the federal and Saskatchewan Governments.

These distributional changes resulted from changes in the federal Government's export tax, its determination of wellhead prices in Canada, and its taxation legislation. They also resulted from changes in Saskatchewan's royalty and taxation provisions and the industry's level of reinvestment in exploration and development. A history of these major changes, and the resulting changes in the distribution of oil revenue per barrel, are outlined in the remainder of this chapter.

Table 6-2
Estimated Distribution of Revenue From Export Barrel of Saskatchewan Crude Oil, 1972-77
(\$/bbl)

	1972	Dec. 1973	Jan. 1974	Apr. 1974	Nov. 1974	Mar. 1975	July 1975	Jan. 1976	July 1976	Jan. 1977
"Export" Price	2.61	5.36	5.66	10.13	11.33	11.13	10.33	11.25	11.35	12.85
Wellhead Price	2.61	3.46	3.46	6.13	6.13	6.13	7.63	7.45	8.50	8.85
Federal Government Share										
Export Tax	0	1.90	2.20	4.00	5.20	5.00	2.70	3.80	2.85	4.00
Income Tax	0.40	0.47	0.31	0.36	1.10	0.98	1.29	1.09	1.29	1.31
	0.40	2.37	2.51	4.36	6.30	5.98	3.99	4.89	4.14	5.31
Saskatchewan Government Share										
Royalty After Incentives	0.27	0.50	0.81	3.21	3.21	2.80	3.78	2.99	3.53	3.61
Income Tax	0.11	0.15	0.10	0.11	0.02	0.02	0.04	0.17	0.21	0.26
	0.38	0.65	0.91	3.32	3.23	2.82	3.82	3.16	3.74	3.87
Industry Share										
"Lifting Costs"	0.55	0.79	0.79	0.84	0.84	0.98	1.00	1.07	1.12	1.17
Net Income After Lifting Costs	1.28	1.55	1.45	1.61	0.96	1.35	1.52	2.13	2.35	2.50
	1.83	2.34	2.24	2.45	1.80	2.33	2.52	3.20	3.47	3.67
Total Shares (= "export" price)	2.61	5.36	5.66	10.13	11.33	11.13	10.33	11.25	11.35	12.85

Notes To Table 6-2

The following assumptions and conditions have been incorporated in the calculations carried out to prepare this Table:

1. The Table outlines the division of revenue in respect of "old" oil produced on Crown lands in Saskatchewan and exported from Canada. In the case of "new" oil (in general, oil produced from a well drilled after January 1, 1974), the Saskatchewan Government's share is lower and the Industry's share is higher.
2. Wellhead and "export" prices are those applicable to medium gravity crude oil produced in southeast Saskatchewan. These prices are sufficiently representative of the weighted average prices for the province's total crude oil production from all areas. The "export" price shown here equals the wellhead price plus the federal export tax.
3. Saskatchewan royalties are calculated on the basis of a production rate of 35 barrels of crude oil per day per well. The term "Royalty After Incentives" refers to the royalty revenue which the Government retains after a portion of the royalty is rebated to the producer to cover a portion of the cost of exploration and development.
4. Estimates of "lifting" (operating) costs are derived from semi-annual producers' cost reports filed with the Department of Mineral Resources. Due to the unavailability of these reports for 1972 and 1977 when this Table was prepared, lifting costs for these years have been estimated.
5. Calculations for each point in time are based on crude oil pricing and royalty-taxation systems in effect at that time.
6. Income tax calculations are for a single year of production. Potential "carry forwards" into later taxation years of the development expense deduction and capital cost allowances have been ignored beyond the initial year and, consequently, result in some overstatement of income tax payments. All capital cost allowances have been assumed to be eligible for the 30% class 10 rate. Depletion has been claimed to the maximum annual allowable rates, assuming that sufficient credits have been accumulated from prior and current years.
7. Industry investment expenditures in Saskatchewan for exploration, development and production facilities have been utilized for the income tax calculations, as outlined in the following table. Wherever possible, investment expenditures in respect of natural gas were excluded from these calculations. Since certain investment expenditures in respect of natural gas could not be identified and excluded, the figures below tend to overstate industry investment in respect of crude oil. This results in

some understatement of income tax payments. Since the simplifying assumptions outlined in point 6 above result in some overstatement of income tax payments, the tax implications of these two simplifying assumptions tend to offset each other. It should be noted, however, that any incorrect estimate of income tax payments does not significantly affect the "Saskatchewan Government Share". The chief result is a change in the distribution of revenue between the oil industry and the federal Government.

	<i>Expenditures on Production Facilities</i>	<i>Exploration Expenditures</i>	<i>Development Expenditures</i>
	(\$ per barrel of production)		
1972	0.13	0.24	0.10
1973	0.15	0.27	0.13
1974	0.22	0.28	0.09
1975	0.18	0.34	0.33
1976	0.22	0.57	0.40
1977	0.26	0.70	0.46

The above expenditure figures are derived from Canadian Petroleum Association Annual Reports, except for the 1977 figures which are estimates by the Department of Mineral Resources. They reflect the investment activities of oil companies in Saskatchewan.

Public Revenues from Oil Resources — Before 1974

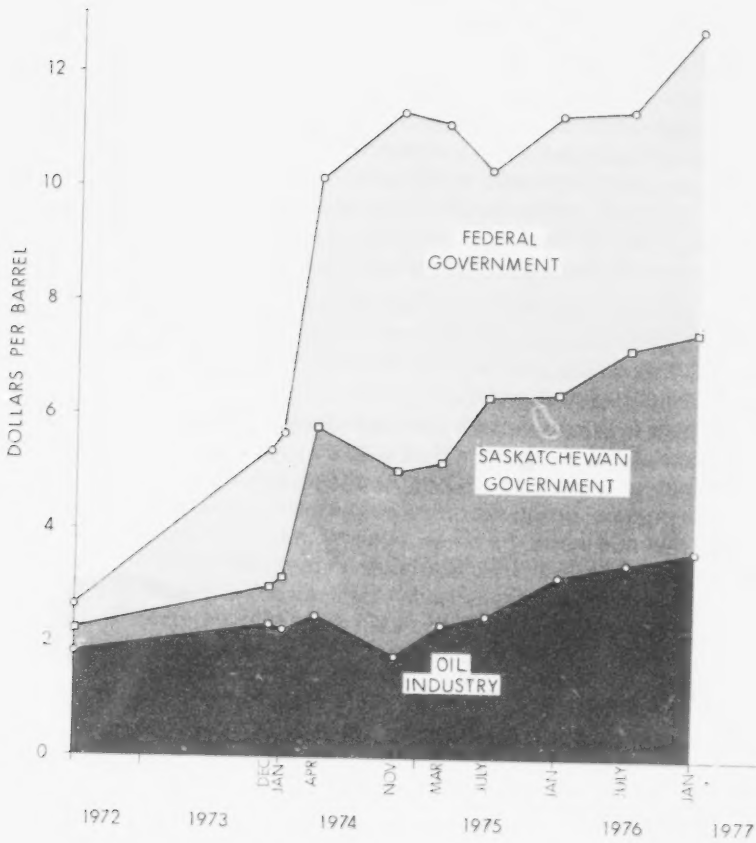
In 1972, the wellhead price of Saskatchewan oil was a little more than \$2.50 per barrel, a price which had prevailed ever since oil production in Saskatchewan began several decades ago. With the exception of small amounts of this price accruing to the Saskatchewan and federal Governments in the form of income taxes and royalties, most of this revenue accrued to the oil industry — to cover their operating or "lifting costs" and to provide a return on their investment.

During the first 9 months of 1973, the wellhead price increased by one-third, to almost \$3.50 per barrel, and it was clear that it would continue to increase. Since the oil industry's costs were not increasing at the same rate, and they were beginning to receive windfall profits, the Saskatchewan Government proceeded to review its taxation and royalty policies vis-a-vis the industry.

At the same time in the fall of 1973, the federal Government began to take measures to obtain an increased share of the value of oil production in Canada. Saskatchewan objected to these measures, on the basis that the provinces have constitutional jurisdiction over natural resources. Moreover

Figure 6-1

ESTIMATED DISTRIBUTION OF REVENUE FROM EXPORT
BARREL OF SASKATCHEWAN CRUDE OIL, 1972-1977



any extraordinary public revenues resulting from these resources should be the cornerstone of provincial revenues. Saskatchewan argued, therefore, that the federal Government should not obtain a larger amount of this revenue base which had been expressly delegated to the provinces.

The federal measures were two-fold. First, they froze the price of oil sold for consumption in Canada, even though the international price of oil continued to rise. Second, they imposed a special tax on every barrel of oil which was exported from Canada. As shown in Table 6-2, Saskatchewan's wellhead price was frozen at about \$3.50 per barrel, even though the export or international price had increased to over \$5.00 per barrel by December, 1973. The difference — \$1.90 per barrel — was export tax revenue.

Given that more than half of Saskatchewan's oil production is exported, the federal Government received a substantial portion of the increased value of the province's oil production. While an agreement was reached whereby the producing provinces received one-half of the proceeds of the export tax revenue collected during October, 1973, to March, 1974, all of the export tax revenue after March, 1974, has accrued to the federal Government. By November, 1974, the export tax reached \$5.20 per barrel, and fluctuated on a monthly basis thereafter.

In December, 1973, having completed its review of taxation policies for the oil industry, the Saskatchewan Government announced its new revenue policy for oil. This policy, which came into effect on January 1, 1974, guaranteed that the net revenue per barrel or revenue "netback" received by oil producers in the province ("industry share") would not fall below the level attained in 1973 — a level which in itself was higher than that achieved in any preceding year. Other than increased revenues to reflect actual higher costs of production, any excess revenue above the 1973 average net revenue would be taxed away by the provincial Government. Moreover, exploration activity undertaken in the province would be rewarded with a reduced royalty rate. A comparison of the industry share in Table 6-2 as of December, 1973, and January, 1974, indicates the essentially unchanged industry share as a result of Saskatchewan's new revenue policy.

Public Revenues from Oil Resources — 1974

In January and March of 1974, the Prime Minister of Canada met with provincial Premiers to discuss the development of a new energy policy for Canada. The result of these discussions was the "March 1974 Oil Agreement". This Agreement established a domestic price (which was well below the export price) for all oil consumed in Canada. For 15 months beginning on April 1, 1974, the average wellhead price for Alberta light

crude oil was set at \$6.50 per barrel. Appropriate adjustments to this base price were allowed to reflect other grades of crude oil and transportation costs.

The Agreement also required the federal Government to reduce its export tax to an amount equal to the difference between the world price and the domestic price. Proceeds from the export tax would be used to subsidize the price of oil in eastern Canada. (As a result of the 1961 National Oil Policy, eastern Canada consumers were importing their oil while consumers living west of the Ottawa valley were being supplied from western Canada. In 1974, Canada's oil exports roughly equalled its oil imports. Consequently, the application of the revenues from the export tax to the cost of importing crude oil at world prices provided the financial means for implementing the \$6.50 per barrel domestic price in all parts of the country.)

Saskatchewan understood that, by foregoing its claim to any of the revenue from the export tax, all revenues up to the \$6.50 per barrel domestic price would be at its disposal to share with the oil industry according to whatever policy the Saskatchewan Government considered to be appropriate. As a result of the March Agreement, the Province considered the issue of federal-provincial oil revenue sharing to be settled until July 1, 1975. In its Budgets of May 6, 1974, and November 18, 1974, however, the federal Government made two fiscal changes which, in Saskatchewan's view, violated the spirit of the March Agreement.

First, as of May 7, 1974, provincial royalties and similar taxes could no longer be deducted as a business expense for income tax purposes. "Non-deductibility" (as this provision came to be known) increased the federal income tax liabilities of Saskatchewan's oil producers by subjecting them to double taxation.

The effect of this change in federal taxation policy is clearly outlined in Table 6-2. In April, 1974, following the increase in the Saskatchewan wellhead price to \$6.13 per barrel, industry was receiving \$2.45 per barrel. As of November, 1974, with the same wellhead price and essentially the same provincial share, industry was receiving only \$1.80 per barrel. While the industry's share decreased by 27% or about \$0.65 per barrel, the federal Government's share from income tax increased by the same amount. This was the direct result of the federal budget.

The second major action by the federal Government which violated the spirit of the March Agreement involved the Province's receipt of Equalization payments. When the March Agreement was being negotiated, it was the understanding of Saskatchewan that if the Province established a special capital fund for any additional oil revenues, Saskatchewan's

Equalization receipts would not be reduced as a result of these revenues. Funds deposited in that fund would not be used for general government expenditures. Since the Province established the Energy and Resource Development Fund into which its additional oil revenue would be transferred, it believed that its Equalization payments would not be adversely affected by the oil price increase.

While this was the Province's understanding on Equalization matters under the March Agreement, the federal Government chose with its November 1974 Budget to make a unilateral change to the method of calculating Equalization. Under the new terms, one-third of provincial oil revenues in excess of the 1973-74 level would be included in the base for calculating a province's Equalization entitlement. The effect of this change was that the non-oil-producing recipients of Equalization (Manitoba, Quebec and the Atlantic provinces) received higher payments because of the expanded Equalization base. Ontario, British Columbia and Alberta were unaffected because their revenue-raising capacity exceeds the national average and, hence, they do not receive Equalization payments. Saskatchewan was the only province to lose Equalization as a result of the federal Government's change in the Equalization formula.

Public Revenues from Oil Resources — 1975

Saskatchewan attempted to ease the burden on oil producers of the federal Government's non-deductibility provision by revising its royalties as of January 1, 1975. The Province also revised its income tax system, through the Saskatchewan Royalty Tax Rebate, to ensure that Crown royalties continued to be fully deductible under the Saskatchewan corporate income tax system. As outlined in Table 6-2, the effect of these Provincial changes on the industry's share was substantial. The majority of the increase in the industry's share between November, 1974, and March, 1975, was due to lower provincial royalties.

The federal Government's June 1975 Budget provided for a \$1.50 per barrel increase in the domestic price of crude oil in Canada. Effective on July 1, 1975, the domestic price would be \$8.00 per barrel for Alberta light crude. Saskatchewan responded by making corresponding adjustments to its royalty structure to take into account the higher prices and the additional federal income taxes resulting from non-deductibility.

A further provision of the 1975 federal Budget (which came into effect on January 1, 1976) was to allow for partial deductibility of Crown royalties by permitting a special "resource allowance" deduction in the calculation of the corporate income tax. Since this provision was accompanied by an increase in the federal corporate tax rate from 28% to 36%, the net effect on

the oil industry's share was marginal. While Saskatchewan welcomed the federal provision of partial deductibility, anything short of full deductibility of Crown royalties is still inadequate because this fails to recognize the fundamental principle that all royalties (whether payable to the Crown or to private interests) are a basic cost of production and similar to any other cost incurred in the process of carrying on productive activities.

The 1975 federal Budget also imposed a 10¢ per gallon excise tax on gasoline consumption. Saskatchewan viewed the excise tax as an encroachment into a traditional tax field of the provinces. The federal Government, on the other hand, justified the tax as a conservation measure (that is, reducing gasoline consumption through higher prices) and as a further source of revenue required to offset the cost of the subsidy on oil imported into eastern Canada.

Toward the end of 1975, Saskatchewan undertook a further review of its taxation policies for oil operations in the province. As a result of rising costs of production and the need for greater exploration and development activity in the province, the Government agreed to raise the industry's "netback" to a level above the 1973 base. The new royalty structure provided special credits for workovers, repairs and maintenance expenditures. It also continued to provide for royalty refunds for exploration and development work carried out in the province.

These adjustments came into effect on January 1, 1976. As indicated in Table 6-2 these changes increased the industry's share to a level which was more than \$0.80 per barrel higher than that which prevailed at the end of 1973.

Public Revenues from Oil Resources — 1976

In the spring of 1976, the federal Government announced two further increases in the domestic price of crude oil. On July 1, 1976, the domestic price of Alberta light crude became \$9.05 per barrel. The export tax and Saskatchewan's royalties were adjusted to take this price increase into account. A further price increase of \$0.70 per barrel, raising the domestic price to \$9.75, came into effect on January 1, 1977.

Public Revenues from Oil Resources — 1977

In the spring of 1977, the Saskatchewan Government announced a new policy for sharing foreseeable crude oil price increases with the industry, assuming that no major alterations in fiscal regimes take place. These price increases would be shared 55%-45% between the Province and the producing companies respectively for production that is classified as "old"

oil (the Provincial share of price increases is lower for "new" oil). This policy was applied in respect of the \$0.70 per barrel increase on January 1, 1977, as well as the \$1.00 per barrel increase on July 1, 1977. This division is designed to enable producers to cover increases in operating costs and income taxes, as well as to provide an increase in net income on each barrel of oil.

Saskatchewan's Proposal for a Canada Energy Security Fund

The issue of how the increased value of oil production should be split between the producing provinces, the federal Government and the oil industry has been a source of debate in Canada since the price of oil began to rise in 1973. In addition, oil consumers have a strong and valid interest in ensuring that the higher prices which they pay will be reinvested so as to increase Canada's energy supplies. The key questions here are: who will receive this additional money, how will it be spent, and who will benefit?

Since the Federal-Provincial First Minister's Conference of April, 1975, Saskatchewan's response to these basic issues has been to propose the establishment of a Canada Energy Security Fund. While this proposal is outlined in detail in a separate publication on this subject¹, the major characteristics of the proposed Fund are as follows:

- (a) oil and gas revenue to the producing provinces and the industry would be based on wellhead prices which would be frozen at their present level, except for increases to offset inflation;
- (b) any revenue from price increases above this level would go into a federal-provincial energy development fund for the purpose of making investments to achieve Canadian self-reliance in energy;
- (c) the money in this fund would be owned 50:50 by the federal Government and the oil-producing provinces. The federal Government, as the major shareholder, would have prime responsibility for directing the fund's investments into energy conservation and development projects;
- (d) the federal Government would restore full deductibility of provincial royalties in calculating corporate income tax.

This proposal, first made by Saskatchewan at the 1975 First Ministers' Conference, has not received sufficient support for its adoption. Its implementation, however, would provide a number of benefits to all parties involved.

¹ *Saskatchewan's Proposal for a Canada Energy Security Fund, April, 1975. Authorized by the Government of Saskatchewan.*

It would provide the federal Government and the governments of oil-producing provinces with a fair share of the oil dollar. It would provide the industry with an increased return on their investment in "old" oil and access to exploration capital in order to find "new" oil in Canada. It would increase the degree of Canadian financial ownership and control of this vital resource industry. Perhaps most importantly, it would guarantee that the revenues from any oil and gas price increase would be reinvested in full to improve energy supply and demand and, therefore, to help achieve energy self-reliance in Canada.

Chapter 7

Energy and the Environment

Introduction

Historically, little attention was given to the environmental consequences of the development and use of energy resources. It was always known that the production and use of energy assists Saskatchewan people in achieving a high standard of living and material comfort. It was also known that Saskatchewan residents enjoy a relatively clean and unspoiled environment — an environment which is free of most of the serious problems which plague more densely populated and industrialized areas.

It is now recognized, however, that the development and use of both renewable and non-renewable energy have environmental consequences. As a result of the increased awareness of these consequences, there is a greater need to carefully evaluate provincial priorities, and to apply energy management principles that accord as much weight to environmental values as to social and economic goals.

It is recognized that the ecological base from which Saskatchewan's energy resources are drawn cannot tolerate unlimited exploitation, and that the ecosystem has only a limited capacity to absorb and withstand pollution and other man-made disturbances. This recognition has resulted in a heightened awareness of the importance to Saskatchewan's well-being of a clean, healthy, and diversified environment.

As the provincial economy develops and diversifies, its energy demand will tend to grow and to create (what is often referred to as) the "energy-environment conflict". This possible conflict presents a challenge to Saskatchewan residents and to their Government to find ways of reconciling these different objectives without sacrificing too much of one for the other.

Environmental Consequences of Energy Development and Use

What are the possible environmental consequences of energy development and use? Saskatchewan's conventional energy resources are oil, natural gas, coal, hydroelectricity, and uranium. The exploration for oil and gas can result in land damage and disruption. The construction of pipelines can also cause land damage, and other possible problems such as blow-outs and oil spills.

Saskatchewan has extensive reserves of lignite coal. These reserves, however, are economically accessible at the present time only through strip-mining, an extraction process with far-reaching environmental effects. Strip-mining can not only create unsightly landscapes but can seriously lower the productivity of the disturbed soil. Mining may also adversely affect ground-water supplies, cause erosion and air pollution, and disturb established social and economic patterns.

The production of electricity from hydraulic sources provides a clean energy product from a renewable resource. It also involves extensive social and environmental change. The requirement for large storage reservoirs can mean changes in river systems and water quality, in addition to the actual flooding of agricultural or forest land.

The mining and processing of uranium have their own special problems, including potential health hazards, difficulties of ensuring safe transport, and the disposal (storage) of radioactive materials.

In addition to possible environmental degradation and pollution problems, energy production and use can compete with other needs for related resources. Examples in this regard include coal mining versus agricultural production in southern Saskatchewan, or the use of water for cooling thermal-electric plants versus other water needs in areas where water is a limited resource.

Measures to Reduce Energy's Impact on the Environment

Considerable progress has been made by Saskatchewan in controlling and reducing the environmental consequences of energy development. This has been accomplished by setting health and safety standards, air and water pollution controls, and policies requiring various types of pollution mitigation such as land reclamation and the clearing of reservoirs. The Government's approach has been twofold: a clean-up approach to solve existing problems, and the development of policies requiring the proponents of various development projects to incorporate environmental and social considerations in the planning of new projects. To this end, the Government has distributed for public review a proposal for an environmental impact assessment policy.

If adopted, this policy would require that all new major development proposals — including energy projects — be reviewed by the Government on the basis of environmental and social criteria, as well as economic considerations. The policy would also require public disclosure of the nature and scope of the required review and of the results of the

proponent's environmental impact study. If warranted, public hearings would be held before a final decision is made on whether or not such a project should proceed.

The Government believes that the adoption of this policy will result in a more balanced perspective on resource development and environmental protection. Although this proposed policy has not yet been officially accepted, there are a number of examples in which it has been applied. These include the proposals to establish electricity generating stations on the Churchill River and at Poplar River, and to establish a uranium mine at Cluff Lake.

The Churchill River Study was established by the Saskatchewan, Manitoba and federal Governments in 1973 to assess the environmental impact of an SPC proposal to build a hydroelectric dam on the Churchill River. The results of this study have been made public, and a Board of Inquiry was appointed early in 1977 to conduct public hearings on the economic, social and environmental effects of the proposed dam. These hearings are currently underway, with a decision expected in 1978.

A Board of Inquiry on the Poplar River Power Project was established in 1974 to review the environmental impact of an SPC proposal to construct a 300 megawatt thermal electric generating station near Coronach. The first set of hearings, held in November 1974, were based on initial environmental findings and resulted in a number of recommendations, most of which were adopted by the Government. A second set of public hearings will be held in 1978 to review the final results of the environmental impact assessment and the reclamation alternatives for the proposed coal mine.

The Cluff Lake Inquiry was established in early 1977 to review environmental studies and gather public views on the proposed uranium mine and milling project at Cluff Lake. Because of public concern regarding the expansion of the uranium industry in Saskatchewan, the inquiry was also directed to examine the broader implications of uranium development (i.e., the health, safety, social and economic effects). Hearings have been completed, with a final report expected in the spring of 1978.

Energy development in Saskatchewan to date has had a relatively small effect on the province's environment. Problems which have arisen in the past have been largely local in scope. Pressure on the environment and the potential for environmental deterioration will increase, however, as provincial energy resources are developed to meet continuing energy demands. In view of this situation, measures are required in addition to that of ensuring that new energy projects are carefully assessed with respect to their environmental and social effects.

The first and most obvious measure is to reduce the growth rate of energy consumption by means of energy conservation. The Government's commitment to this goal, and its Energy Conservation Program to achieve it, are outlined in Chapter 3. A further measure is that of research into and support for the use of alternative, low-impact energy technologies in the province.

Wind, solar and biomass energy have the advantage of being relatively pollution-free and renewable sources. They will have some environmental impact if widely-used but not the concentrated impact of conventional energy sources. Saskatchewan's research and development activities regarding these and other potentially useful energy supplies is the subject of Chapter 8 — Energy Research and Development.

Based on the principles and practices outlined in this chapter, the Province will ensure that the environmental consequences of energy development and utilization are known in advance, carefully weighed and appropriately minimized. This approach means that the environmental aspects are accorded the same degree of consideration as the social and economic aspects of energy resource management in Saskatchewan.

Chapter 8

Energy Research and Development

Introduction

The extent and sophistication of energy research (the search for new technology) and development (the demonstration of the feasibility of new technology) has closely paralleled the rise of industrialized society. The settlement of the Canadian West was directly dependent upon the research that produced steam locomotives powered by coal. Since the coming of the railroad, the face of Saskatchewan has been altered by energy research and development (R and D) efforts which replaced horsepower with the diesel tractor, kerosene lamps with electric light, and the wood stove with central heating. While much of the energy R and D which had an impact on the province was done elsewhere, significant original work has been conducted in Saskatchewan.

One of the most important examples of original research and development that improved the quality of life and reduced costs to all Saskatchewan residents was the rural and urban electrification program. In this instance Saskatchewan Power, a Crown corporation, overcame through research and development several technical problems related to the transportation of electricity. This R and D effort not only made available a secure supply of energy at reasonable prices but also resulted in the bringing together of expertise which facilitated efforts to reduce the environmental impacts of electricity production.

The nature of Saskatchewan's climate, geography, economy and population has necessitated the use of a great deal of energy for heating, transportation, agriculture and other activities. Further R and D can help ensure that in an era of high prices and more limited supplies, additional energy sources will be "found", and the efficiency whereby energy is recovered, transported, converted and used will be improved.

Saskatchewan Energy Research and Development

Given the limited resources of the province, the objective of energy R and D activities is to examine problems which constitute a major obstacle to the discovery, recovery, transportation, storage, conversion or final use of energy in Saskatchewan. With respect to ensuring future energy supplies

the role of R and D is to facilitate over the longer term an acceptable transition from an over-dependence on the relatively scarce non-renewable resources of oil and gas, to a greater reliance on a broader range of more abundant energy supplies. Historically, R and D funding by the Saskatchewan Government has been primarily directed towards increasing the supply of conventional energy resources and the efficiencies of use. Due to the need for a greater diversity of energy sources, increased attention has been given more recently to developing new types of energy supply.

Table 8-1 outlines the level and type of estimated energy R and D expenditures by Saskatchewan Government agencies in the current fiscal year. (These figures do not include expenditures by universities or private industry in the province.) The majority of such expenditures are carried out by the Saskatchewan Power Corporation and the Department of Mineral Resources. More detail on the activities of SPC's Research and Development Centre can be found in a separate publication.¹

Some of the major examples of these energy R and D activities are as follows:

1. *Exploration/Evaluation*

- (a) investigation of the quantity and quality of Saskatchewan *lignite* under the nearly completed, 6 year, \$2 million Canada-Saskatchewan Coal Resource Program.
- (b) determining areas which are likely to contain *uranium* deposits under the five-year Canada-Saskatchewan Uranium Reconnaissance Program.

2. *Recovery*

- (a) evaluation of electricity production from *wind power* by SPC. Expenditures to date — \$63,000.
- (b) non-contract research by the Saskatchewan Research Council into *solarenergy* systems. Expenditures to date — \$31,000.
- (c) experimental use of power plant *waste heat* by SPC. Expenditures to date — \$64,000.
- (d) pilot projects to demonstrate techniques of recovering greater proportions of *heavy oil* resources, under the \$16.2 million Canada-Saskatchewan Heavy Oil Agreement.

Seven Years of Progress, 1970-1977. Saskatchewan Power Corporation, Research and Development Centre.

Table 8-1
Estimated Energy Research and Development Expenditures
By Saskatchewan Government Agencies, 1977-78
(\$'000')

Energy Activity	Energy Conservation	Oil and Gas	Non-Renewable			Renewable			Electricity	Other	Total
			Coal	Peat	Uranium	Solar	Wind	Hydro			
Exploration/ Evaluation		334	387	53	730						1,504
Recovery		1,000	9		170	67	19	112	62		1,439
Conversion from one form to another											295
Transportation		87	75						528		690
Final Use	121										121
Other										158	158
Total	121	1,421	766	53	900	67	19	112	62	528	4,207

3. *Conversion*

- (a) research by SPC with respect to improving the efficiency of *converting coal* to electricity. Expenditures to date — \$60,000.
- (b) SPC research into the conversion of coal to *substitute natural gas*. Expenditures to date — \$165,000.

4. *Transportation*

- (a) contract research by the Saskatchewan Research Council on the movement of coal by *slurry pipeline*. Expenditures to date — \$310,000.

5. *Final Use*

- (a) research, construction, demonstration and monitoring in respect of an *energy conservation* and *solar energy* house by the Department of Mineral Resources and the Saskatchewan Housing Corporation. Estimated cost of the house (excluding costs of land, solar system and research) — \$70,000.
- (b) development by SPC of new energy utilization technology in the form of an *off-peak electric storage* heating system. Expenditures to date — \$293,000.

Total expenditures by Saskatchewan Government agencies on energy research and development have increased from \$2 million in 1974-75 to \$4.2 million in 1977-78. This increase in expenditures of over 100% in only 3 years reflects the Government's commitment to energy research and development as a means of increasing Saskatchewan's energy supply options and improving the efficiency with which energy is recovered, converted, transported and used.

Chapter 9

The Long Term Energy Situation

Introduction

The preceding chapters outline the broad principles and practices which Saskatchewan applies to the management of energy resources. These have not been applied rigidly to every situation and the principles will continue to evolve in the face of rapid changes in the energy environment. From time to time, major changes in approach are required.

Chapter 4 (Security of Energy Supply) indicated in general terms the degree to which reliance can be placed on particular fuel sources to meet future Saskatchewan requirements. The time period involved was the next 10 to 15 years or more. Given the vital importance of energy to Saskatchewan residents and the long lead times required to substantively change energy demand and supply activities, however, a longer planning horizon is required. A time period of 25 to 50 years is not inappropriate, given the importance and difficulty of the matters involved.

New Perspectives

Definitive energy supply and demand forecasts for Saskatchewan into the next century do not currently exist. Certain observations can be made, however, on the basis of Canadian and international forecasts in respect of two energy fuels that currently are vital to Saskatchewan's energy requirements — crude oil and natural gas.

In the case of crude oil, the National Energy Board's 20-year forecast of February, 1977, indicates that domestic oil supply is expected to fall short of total Canadian requirements by about one-third in 1985 and by at least as much as this between 1990 and 1995. Imported crude oil will be required in the early 1980's in some Canadian markets now served by Canadian crude. Thus, Canada's dependence on imported crude oil is forecast to increase in the future.

The availability of sufficient crude oil imports in the 1980's and 1990's, however, is becoming more and more doubtful. Studies undertaken by the United States Government and a private international study group (the Workshop on Alternative Energy Strategies) suggest that, during the 1980's and later, the world supply of crude oil could be insufficient to meet demand.

The resultant shortages or very high prices could affect all oil-importing countries, including Canada. In such a situation, all provinces would be faced with the need to conserve — and perhaps ration — those supplies which are available from domestic and external sources. Saskatchewan's ability to rely on sufficient imports of crude oil from Alberta, therefore, is becoming more tenuous.

The situation in respect of natural gas is somewhat better. To meet its requirements for natural gas, Saskatchewan will have to continue to import a portion of its supplies from other Canadian sources. Imports from Alberta will eventually become more difficult to secure and "frontier" supplies (from the Arctic or offshore Eastern Canada) cannot yet be counted upon to fill the "gap". Even this latter source, however, might only last for several decades at best. In terms of a planning horizon extending into the next century, conventional supplies of natural gas will eventually become insufficient.

There is some prospect for the conversion of Saskatchewan lignite to liquefied (petroleum) fuels and substitute natural gas. The lead times involved are substantial, however, and these sources are not economically feasible at the present time. They are not energy supplies that can be counted upon in the near future.

New Initiatives

Faced with these long-term prospects in respect of crude oil and natural gas, fuels which currently supply about 90% of Saskatchewan's energy consumption, a departure from historic strategies and an improvement in energy management programs and capabilities are required.

It has been pointed out by various writers on long-term energy planning, in commenting on the difficulties of converting from scarce fossil fuels to more abundant fossil and renewable fuels, that adequate conversion time is the most precious resource possible. This is as true in Saskatchewan as elsewhere.

The province needs time to begin to move away from its heavy dependence on oil and natural gas — time to examine, evaluate, test, develop and apply "unconventional" sources of energy such as gasified or liquefied lignite, waste heat from thermal power stations, district heating, liquid fuels from forestry resources, solar energy and wind power. Each source requires careful evaluation to determine its appropriateness from the point of view of such criteria as technical feasibility, security of supply, environmental impact and economics. Such evaluation requires intensive research which can take many years to complete.

Expanded Energy Conservation Program

Additional time to investigate alternate long-term sources of energy can be gained by minimizing energy consumption, as outlined in Chapter 3. While it has been apparent for some time that heavy dependence on oil and gas could not continue forever, the more recent forecasts give rise to much greater concern — particularly in the case of crude oil. Faced with these forecasts, Saskatchewan is preparing a major expansion of its Energy Conservation Program.

This expansion involves the establishment of an Office of Energy Conservation, with a substantial budget covering a number of information, advisory and incentive programs. More details of this Program expansion will be outlined at an early date. In essence, however, this second phase of Saskatchewan's Energy Conservation Program should have a significant impact in terms of reducing the growth rate of energy consumption in the province. In addition to its economic and environmental benefits, this major expansion will provide more time for the province's conversion to longer-term, sustainable sources of energy supply.

Coordination of Energy Research and Development

A second required component in Saskatchewan's long-term energy program is greater co-ordination of, and emphasis on, energy research and development (R and D). Several provincial agencies (including, in particular, the Saskatchewan Power Corporation) are currently involved in energy R and D, with beneficial results in the context of these agencies' objectives. There is not, however, a central focus for all of these efforts to ensure that, from a provincial point of view, all relevant options are being considered.

The Government is establishing, therefore, in the Department of Mineral Resources, a capability for the co-ordination of energy R and D. This will involve the monitoring of energy R and D efforts within Saskatchewan and elsewhere, with a view to understanding what work is already being done. It will also involve a determination of new technologies which would have the greatest relevance to Saskatchewan's situation. Subsequently, measures will be taken to encourage additional R and D activities. Such encouragement would be given to R and D in respect of technologies which could be relevant to the province, which are not being evaluated elsewhere, and in respect of which a Saskatchewan R and D effort could make a substantial contribution.

This co-ordination of energy research and development, in conjunction with research and development programs of SPC and other provincial agencies, will ensure that Saskatchewan will be fully aware of the potentials

and pitfalls of "unconventional" energy technologies. It will provide the basis for an expanded research and development program of relevance to Saskatchewan's energy needs. It will also provide vital information to the longer term planning and management of energy resources in the province.

Comprehensive Energy Forecasting

A third necessary function in Saskatchewan's energy management and planning activities is that of comprehensive energy forecasting. Perhaps the greatest value of comprehensive forecasting is that it requires and involves a detailed understanding of the structure and relationships of the energy "system". It indicates which factors are crucial in determining energy demand and supply and which economic, social and technological changes could be made in order to maintain energy demands and supplies in an appropriate balance.

In view of the important nature of this function, the Department of Mineral Resources will expand its current efforts in this area and develop the capability to prepare and publish forecasts of Saskatchewan energy demand and supply in conjunction with other provincial agencies. Such forecasts, in turn, will greatly assist in the planning and management of energy resources in Saskatchewan.

In broad terms, the only solution to the increasing difficulties and costs of obtaining long term energy supplies is to reduce our energy demands and to develop new technologies to apply to old and new sources of energy (e.g., heavy oil recovery, coal gasification and solar). A related requirement is a better understanding of and ability to forecast changes in energy demands and supplies. By means of an expanded effort in the areas of energy forecasting, energy conservation and energy research and development, the Government will ensure that the long term energy future of Saskatchewan will be better managed in the interests of the residents of the province.

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